AD-A017 760

DEVELOPMENT OF RMS COST MODEL AND DEMONSTRATION OF ALTERNATIVE OH-58 MAINTENANCE SCENARIOS

Larry E. Clay, et al

Technology, Incorporated

Prepared for:

Army Aviation Systems Command

July 1975

USAAVSCOM
Technical Report 75-27

TECHNOLOGY INCORPORATED

INSTRUMENTS AND CONTROLS DIVISION

DEVELOPMENT OF RMS COST MODEL AND DEMONSTRATION OF ALTERNATIVE OH-58 MAINTENANCE SCENARIOS

By:

Larry E. Clay
James E. Kirchmer

July 1975

USAAVSCOM Technical Report 75-27
Contract No. DAAJ01-74-C-0839(P1G)

Prepared for:

R & M DIVISION DIRECTORATE FOR PRODUCT ASSURANCE
U.S. ARMY AVIATION SYSTEMS COMMAND

APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED

3821 COLONEL GLENN HIGHWAY • DAYTON, OHIO 45431

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER USAAVSCOM-TR-75-27	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) DEVELOPMENT OF RMS COST MODEL AND DEMONSTRATION OF ALTERNATIVE OH-58 MAINTENANCE SCENARIOS		5. TYPE OF REPORT & PERIOD COVERED Final Report: June 1974 to November 1975
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Larry E. Clay, James E. Kirchmer		8. CONTRACT OR GRANT NUMBER(s) DAAJ01-74-C-0839(P1G)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Technology Incorporated, 3821 Colonel Glenn Hwy., Dayton, Ohio 45431		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Directorate of Product Assurance, U.S. Army Aviation Systems Command, St. Louis, Missouri 63166		12. REPORT DATE July 1975
		13. NUMBER OF PAGES 76
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE --

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

OH-58 aircraft
reliability
operating costs
cost analysis
simulation

20 ABSTRACT (Continue on reverse side if necessary and identify by block number)

For several years, the Army has employed the Reliability and Maintainability Simulator (RMS) computer program to simulate the operation and maintenance of helicopter fleets of up to 24 aircraft. However, since the basic RMS model did not include cost information, the economic consequences of changes in the maintenance procedures could not be projected, and the cost effectiveness of contemplated reliability improvements could not be

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

20.

evaluated. Consequently, to remedy these deficiencies, the RMS model was revised and expanded to an RMS COST model by adding a cost computation to determine all operating and maintenance costs during the simulation period. The resultant RMS COST model was demonstrated by executing a simulation of an OH-58 helicopter company with a baseline mission and maintenance system scenario and then with six alternative scenarios. The cost analysis techniques used in the RMS COST model development and the model itself are described, the output cost parameters are defined, and the simulated OH-58 maintenance system alternatives are compared. A user's manual and program source decks were prepared and submitted as separate data items.

TECHNOLOGY INCORPORATED
DAYTON, OHIO

TI-069220-75-06

DEVELOPMENT OF RMS COST MODEL AND DEMONSTRATION OF ALTERNATIVE OH-58 MAINTENANCE SCENARIOS

FINAL REPORT

Contract No. DAAJ01-74-C-0839(P1G)

Prepared for:

R & M Division
Directorate for Product Assurance
Aviation Systems Command
12th and Spruce Streets
St. Louis, Missouri

PREPARED BY Larry E. Clay Larry E. Clay	CHECKED BY J. E. Gallico J. E. Gallico - Technical Editor
James E. Kirchmer James E. Kirchmer	APPROVED BY Larry E Clay Larry E. Clay - Program Manager
COMPLETED July 1975	APPROVED BY R. B. Johnson, Manager Systems Analysis Department

REVISIONS

LET	DATE	BY	NO. PAGE	CHANGES	PAGES AFFECTED

ORIGINAL NO PAGES

FOREWORD

This final technical report was prepared by Technology Incorporated per the requirements of Item No. A003 of Contract DAAJ01-74-C-0839(P1G). The report documents the development of a cost subroutine modification to an existing Reliability and Maintainability Simulator (RMS) and the testing of the modified RMS by using several maintenance system alternatives for the OH-58 helicopter.

The program was sponsored by the R&M Division of the AVSCOM Product Assurance Directorate. Mr. Lewis Neri, R&M Division Chief, served as the Contracting Officer's representative and Mr. Lindell Whaley was the alternate representative. At Technology Incorporated the program was performed under the general supervision of Mr. Raymond B. Johnson, Systems Analysis Department Manager. Mr. Larry E. Clay served as Program Manager.

ABSTRACT

For several years, the Army has employed the Reliability and Maintainability Simulator (RMS) computer program to simulate the operation and maintenance of helicopter fleets of up to 24 aircraft. However, since the basic RMS model did not include cost information, the economic consequences of changes in the maintenance procedures could not be projected, and the cost effectiveness of contemplated reliability improvements could not be evaluated. Consequently, to remedy these deficiencies, the RMS model was revised and expanded to an RMS COST model by adding a cost computation to determine all operating and maintenance costs during the simulation period. The resultant RMS COST model was demonstrated by executing a simulation of an OH-58 helicopter company with a baseline mission and maintenance system scenario and then with six alternative scenarios. The cost analysis techniques used in the RMS COST model development and the model itself are described, the output cost parameters are defined, and the simulated OH-58 maintenance system alternatives are compared. A user's manual and program source decks were prepared and submitted as separate data items.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

1. INTRODUCTION

1.1 Background

As part of its reliability and maintainability program for Army helicopters, the U.S. Army Aviation Systems Command (AVSCOM) has employed the Reliability and Maintainability Simulator (RMS) computer program. Written several years ago in GPSS V, this program has been modified several times to more closely simulate current Army helicopter operation and maintenance. The latest modification adapted the program to the new three-level maintenance concept (AVUM, AVIM, and Depot) to replace the older four-level system (Unit, Direct Support, General Support, and Depot). Among the latest program documents available through AVSCOM are "Army Simulation Model Software Package," "Description of Model Internal Operations," and "ARMS Input Forms."

The RMS program simulates the operation of a company of up to 24 helicopters flying a prescribed mission type. The program simulates the mission call, preflight inspection, flight, postflight and daily inspections, periodic inspections, unscheduled maintenance, component replacement and repair at the field or depot level, test hops as required, and return of aircraft to the ready pool. Unscheduled maintenance and component failure are simulated on a probabilistic basis; such failures (perhaps causing an abort) can be detected in flight or during any of the inspections. Manpower limitations are included so that aircraft can be held NORM to await available maintenance manpower.

To support the extensive input requirement of the basic RMS program, AVSCOM recently developed a Fortran program to generate a large portion of the input data. This program was used to develop the input data for the seven OH-58 test alternatives executed during the RMS COST demonstration.

1 2 RMS COST Modification

Since the basic RMS model did not include cost information, it could not project the economic consequences of changes in the system reliability or in the maintenance procedures, nor could it provide the savings associated with an increase in MTBF. Consequently, the R&M Division could not evaluate the cost effectiveness of contemplated reliability improvements.

Accordingly, Technology Incorporated was awarded a contract to modify the RMS model by adding a cost computation to determine total operating and maintenance costs during the simulation period. To execute the RMS program when some or all of the cost input data is unavailable, the modified program was designed to bypass the cost computation on command of an input switch. The revised model is called the RMS COST model.

1.3 RMS COST Model Demonstration

The RMS COST model was demonstrated by executing a simulation of an OH-58 helicopter company with a baseline mission and maintenance system scenario and then with six alternative scenarios.

This report presents the cost analysis techniques, the description of the RMS COST model, the output cost parameters, and a comparison of the simulated OH-58 helicopter maintenance system alternatives.

The user's manual (Reference 1) for the RMS COST model contains the operating instructions, the cost input requirements, a description of the Fortran cost subroutines, a detailed listing of the modifications to the basic RMS code, and a sample of the RMS COST output. This manual does not contain instructions or input data requirements for the basic RMS model.

2. COST ANALYSIS TECHNIQUES

The cost of ownership (COO) philosophy used to develop the costing techniques of the RMS COST model is described in the AVSCOM R&M Manual (Reference 2). The terminology and definitions in the RMS COST model were correlated with those in AR 37-18, Reference 3. The cost equation is represented by (1) development costs (DC), (2) production costs (PC), and (3) operating and maintenance costs (OMC):

$$COO = DC + PC + OMC$$

The development cost (DC) is based upon the estimated costs for applied research, engineering design, development, testing, and evaluation.

The production costs (PC) include nonrecurring (IN) and recurring (IR) investment costs and program management (PM):

$$PC = IR + IN + PM$$

As stated in Reference 4, the recurring investment costs include costs of components installed in delivered systems and of the initial procurement of spares to satisfy pipeline requirements. The nonrecurring investment cost includes those costs associated with placing a component in operational service that are not reflected in unit-cost procurements of the component. The costs for administration are included in the program management cost. The combined development and production costs make up the total acquisition cost (AC), that is,

$$AC = DC + PC$$

and

$$COO = AC + OMC.$$

The operating and maintenance costs of the system include (1) inspection cost (IC), (2) flight cost (FC), and (3) maintenance cost (MC):

$$OMC = IC + FC + MC$$

The cost items of the RMS simulation that are applicable to the inspection are the consumables, overhead, and manpower. The flight costs associated with the number of flight hours include the crew and flight consumables (POL) costs. The maintenance costs are defined in terms of each of the three levels: unit (AVUM), intermediate (AVIM), and depot. Included in each level are costs for personnel, consumables, overhead, components, transportation, pipeline, and salvage. The salvage value is treated as a negative cost, that is, dollars which are returned to the system. The pipeline cost is based on the method developed in Reference 5. The RMS pipeline cost includes costs for replacement of items that are condemned or retired and for replenishment of the component inventory.

The costing in the RMS COST model includes two categories: acquisition costs and operating and maintenance costs. The cost output from the model is described as the total cost of ownership for the given simulation period. Since the model is only executed for short periods of the actual helicopter life, the large total acquisition cost would adversely affect the cost output. Therefore, to keep the cost in perspective, the acquisition cost is considered as a depreciation cost per flight hour. For the baseline and demonstration runs, the acquisition cost was computed by a straight-line type of depreciation.

The techniques used in determining the operating and maintenance costs were based on the cost items available in the RMS COST model. The simulation provides the basic parameters of the RMS cost equations, namely, the manpower and the number of occurrences of the various operation and maintenance events.

The inspection costs are presented in terms of the five types of RMS inspections: preflight, postflight, daily, intermediate, and periodic. The AVUM inspection and unscheduled maintenance personnel costs include both direct and indirect labor costs. Subsystem costs comprise the cost of component repair or replacement at each of the major sources: AVUM, AVIM, depot, and pipeline.

3. EXTENDED RMS

3.1 Basic Model and Insertion of Cost Logic

The basic flow chart for the RMS simulation computer program written in GPSS V for the IBM 360/65 was extended to include the capability of determining the cost for the simulated Army helicopter operations and maintenance. The costing techniques are based on the cost contributing factors noted in Figure 1, the RMS flow chart.

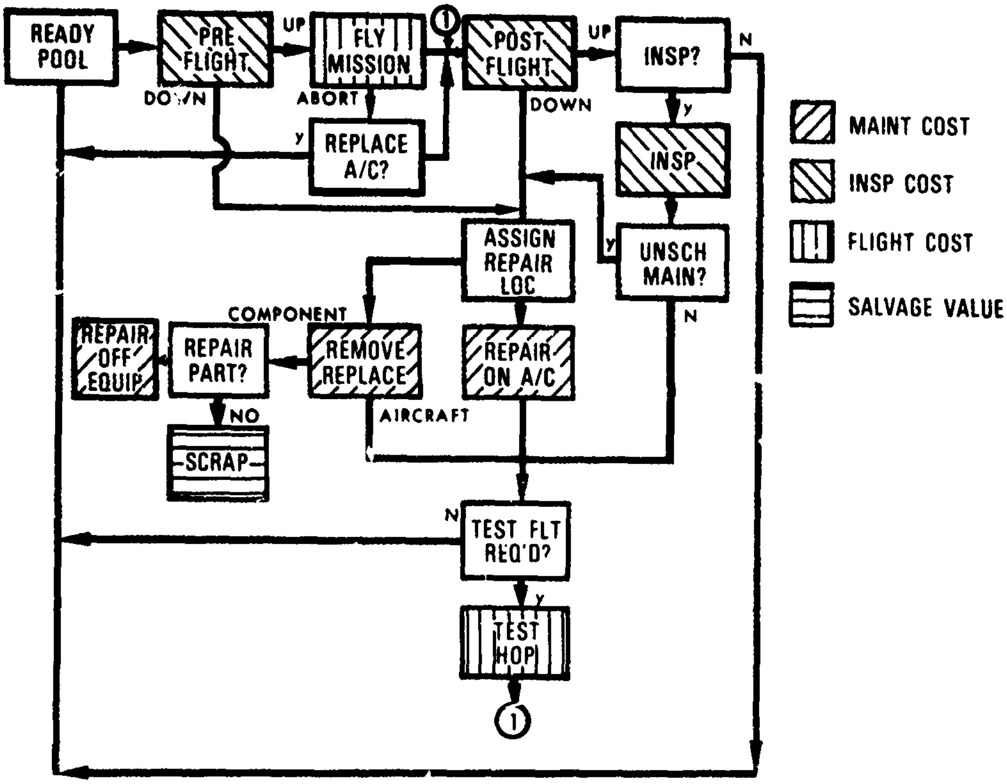

Figure 1. RMS Flow Chart

The RMS cost calculations are performed by a Fortran subroutine programmed to interface with the RMS model. This arrangement, rather than inserting the cost logic directly into the RMS model, was chosen to keep the basic RMS model logic intact and to permit execution of the RMS model without cost computations and their attendant increases in computer time and memory requirements. The Fortran subroutines were also chosen because of the difficulty of handling the input and the lack of output flexibility with GPSS V.

To execute the 6-month OH-58 demonstration model with cost computations required 300K bytes of core storage and a run time of the central processing unit of about 3.5 minutes.

As indicated in Figure 1, the simulation begins with a call for one or more helicopters from the ready pool. The number of helicopters sent from the ready pool to preflight inspection will be equal to the number requested for flight and standby unless the ready pool does not contain this many aircraft in which case fewer aircraft will be sent. At the preflight inspection block, manpower and time to perform the inspection are assigned to this event. On the basis of a probabilistic function, the inspected aircraft will be either readied for flight or grounded for maintenance action. Grounded aircraft are replaced by standby aircraft if such aircraft are available. Aircraft launched on the mission will either complete the mission or abort. Aborting aircraft proceed to postflight inspection and are replaced in the mission by standby aircraft if the launch window permits. Although not used for the OH-58 simulation, the postflight inspection block functions similarly as the preflight inspection block. Following the postflight inspection block is a decision block which determines whether each aircraft is due for a scheduled daily, intermediate, or periodic inspection. If no inspection is due, the aircraft is returned to the ready pool; otherwise, the aircraft is sent to the appropriate inspection. During inspection, manpower and time to perform the inspection are assigned to the event. A probabilistic function determines whether the aircraft requires unscheduled maintenance action. If not, the aircraft are checked for a test hop requirement; otherwise, they are sent to the appropriate repair location.

Each unscheduled maintenance action is assigned to one of the components within one of the subsystems on the basis of a random draw from a probability distribution. Either this action is performed on the aircraft or the component is removed and replaced; if the component is removed, it is repaired at the unit, intermediate, or depot level or it is scrapped if not repairable. Each repair action and each remove and replace action is assigned manpower and maintenance time at the appropriate station. Scrapped components are assigned a salvage value (from the input data) which is a negative expenditure. In addition to man-hour cost, the cost at the repair locations includes overhead, component, consumables, and transportation costs. It is assumed that all off-equipment components that are repaired are returned to the inventory.

After scheduled inspections or unscheduled maintenance, all aircraft are sent to a block which determines whether a test flight is required because of the work performed. If no test flight is required, the aircraft is sent to the ready pool. If a test flight is required, a flight cost identical to that for a regular mission (that is, for crew and consumables) is assigned, and after the test hop the aircraft is sent to postflight inspection.

3.2 Input Requirements for RMS COST

The cost logic was added to the RMS GPSS V program to permit executing simulations with or without the cost computation. When the costing algorithms are to be ignored, the only special input requirement is setting a single-digit switch within the model.

A set of input data cards must be provided to use the cost routines. As shown in Figure 2, the card setup consists of six input data categories. The cost parameters within these categories are presented in Figure 3. The number of cards used in each category depends on the number of MOS types, subsystems, and components simulated. There must be one card for each AVUM, AVIM, and Depot MOS used in the simulation. There must also be one card for each subsystem and component. The individual cost parameters of each card can be assigned a zero value.

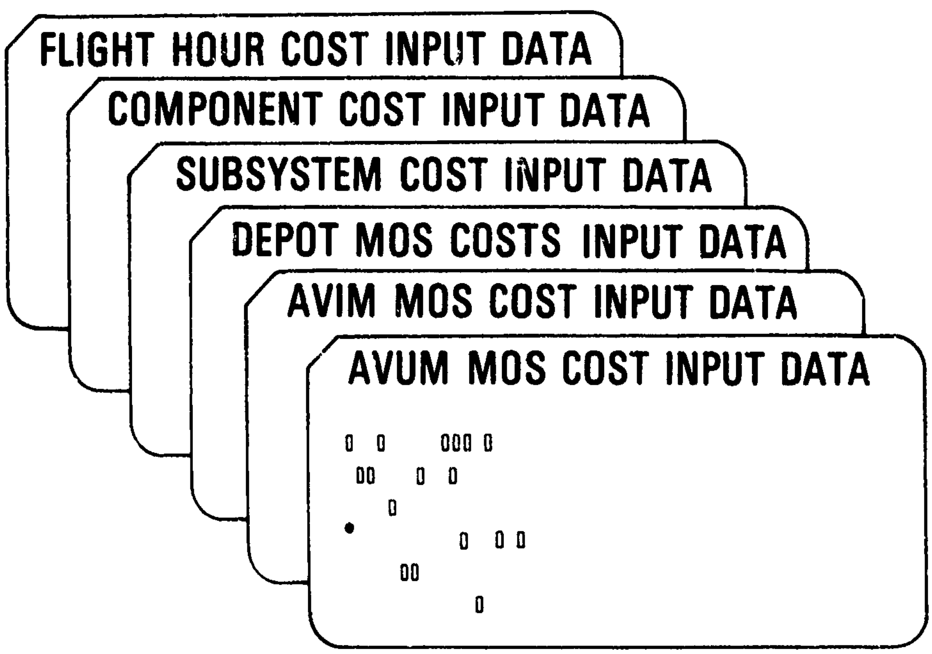

Figure 2. Input Card Setup for RMS COST Data

AVUM, AVIM AND DEPOT MOS INPUT DATA

- MOS TITLE
- AVERAGE HOURLY WAGE PER MOS
- AVERAGE HOURLY OVERHEAD RATE PER MOS
- AVERAGE CONSUMABLE COST PER EVENT
- OVERTIME FACTOR FOR AVUM MOS TYPES

SUBSYSTEM COST INPUT DATA

- SUBSYSTEM TITLES
- NUMBER OF COMPONENTS PER SUBSYSTEM

COMPONENT COST INPUT DATA

- COMPONENT COST
- COMPONENT SALVAGE VALUE
- TRANSPORTATION COST – AVUM TO AVIM
- TRANSPORTATION COST – AVIM TO DEPOT
- COMPONENT CONSUMPTION COST – PARTS & MATERIALS
- AVUM, AVIM AND DEPOT CYCLE TIME

FLIGHT HOUR COST INPUT DATA

- DEPRECIATION RATE PER FLIGHT HOUR
- FLIGHT COST PER FLIGHT HOUR
- CONSUMABLE COST PER FLIGHT HOUR

Figure 3. RMS COST Model Input Parameters

4. RMS COST PARAMETERS

4.1 RMS Inspection Costs

Table I, RMS Inspection Cost, lists a cost for each inspection type at each AVUM MOS level. The hourly MOS manpower rate, the hourly overhead, and the consumable rate per event are input to the cost routine via the card data. The inspection costs consist of costs for manpower, overhead, and consumables:

$$COST(I,J) = MMH(I,J)*(MRT(I)+ORT(I))+NIN(I,J)*CRT(I)$$

where

I = number of the AVUM MOS LEVEL

J = inspection type (preflight, postflight, daily, intermediate, and periodic)

MMH = total inspection man-hours

MRT = hourly manpower rate

ORT = hourly overhead rate

NIN = total number of inspections

CRT = consumable rate for each inspection

TABLE I. SAMPLE TABLE - RMS INSPECTION COST

MOS NO	PRE FLIGHT	POST FLIGHT	DAILY	INTER-MEDIATE	PERIODIC	TOTAL	PERCENT
1	X	X	X	X	X	$X	P
2	X	X	X	X	X	$X	P
3	X	X	X	X	X	$X	P
•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•
N	X	X	X	X	X	$X	P
TOTAL	X	X	X	X	X	$X	100%
PERCENT OF TOTAL	P	P	P	P	P	100%	

4.2 RMS Personnel Costs

Table II, Inspection and Unscheduled Maintenance Personnel Costs, lists costs for AVUM direct labor, indirect labor, and overtime personnel:

$$REG(I) = (MMH(I)-OMMH(I))*MRT(I)$$

$$OT(I) = OMMH(I)*(MRT(I)*OTR(I))$$

$$IND(I) = (AVL(I)-MMH(I))*MRT(I)$$

$$TOT(I) = REG(I)+OT(I)+IND(I)$$

where

I = AVUM MOS number
REG = direct cost for regular labor hours
MMH = total maintenance man-hours
MRT = hourly manpower rate
OT = overtime cost
OMMH = overtime maintenance man-hours
OTR = factor for overtime rate difference
IND = indirect cost
AVL = total available man-hours during the simulation
TOT = total personnel cost

TABLE II. SAMPLE TABLE - INSPECTION AND UNSCHEDULED MAINTENANCE PERSONNEL COSTS

MOS	DIRECT REG.	DIRECT OT	INDIRECT	TOTAL	PERCENT
1	X	X	X	X	P
2	X	X	X	X	P
3	X	X	X	X	P
•	•	•	•	•	•
•	•	•	•	•	•
•	•	•	•	•	•
•	•	•	•	•	•
11	X	X	X	X	P
TOTAL	$X	$X	$X	$X	100%
PERCENT OF TOTAL	P	P	P	100%	

4.3 Subsystem Maintenance Costs

Table III, Subsystem Maintenance Action Costs, lists the accumulated subsystem costs at the AVUM, AVIM, and depot maintenance levels, the cost to maintain the pipeline inventory, and the salvage value of the condemned components of the subsystem. The parameters to compute the subsystem cost include personnel, MOS overhead, MOS consumables, components, component consumption, pipeline, transportation, and salvage (negative cost) costs:

$$\text{AVUM(SYS)} = \sum_{P=1}^{N} \text{MMH(P)*(MRT(I)+ORT(I))+NEVT(P)*CMOS(I)}$$
$$\text{+OTMH(P)*(OTF-1.0)}$$

$$\text{AVIM(SYS)} = \sum_{P=1}^{N} \text{MMH(P)*(MRT(K)+ORT(K))+NEVT(P)*(CMOS(K)+CPRT(P)}$$
$$\text{+ TRN1(P))}$$

$$\text{DEPOT(SYS)} = \sum_{P=1}^{N} \text{MMH(P)*(MRT(J)+ORT(J))+NEVT(P)*(CMOS(K)}$$
$$\text{+CPRT(P)+TRN2(P))}$$

$$\text{SALV(SYS)} = \sum_{P=1}^{N} \text{CND(P)*SLV(P)}$$

$$\text{PLC(SYS)} = \sum_{P=1}^{N} \text{(CND(P)+PLN(P))*PCST(P)}$$

$$\text{PLN(P)} = \text{UNC(P)+INC(P)+DNC(P)}$$

$$\text{UNC(P)} = \text{CPU(P)*(HSU(P)/HT)}$$

$$\text{INC(P)} = \text{CPI(P)*(HSI(P)/HT)}$$

$$\text{DNC(P)} = \text{CPD(P)*(HSD(P)/HT)}$$

where

SYS = subsystem number
P = component number
N = number of components in the subsystem
MMH = total number of maintenance man-hours (including overtime at the AVUM level)
MRT = hourly manpower rate
I = AVUM MOS number
ORT = hourly overhead rate
NEVT = number of occurrences of a particular event
CMOS = MOS consumable rate
CPRT = component-associated consumables and materials cost
K = AVIM MOS number
TRN1 = transportation cost from AVUM to AVIM
J = depot MOS number
TRN2 = transportation cost from AVUM to depot
PCST = part cost
SALV = total salvage value, which is a negative cost
PLC = pipeline cost
OTMH = overtime maintenance man-hours
OTF = overtime factor
CND = number of times a part is condemned
PLN = number of components required to maintain inventory
UNC = number of components from AVUM required to maintain the inventory
INC = number of components at the AVIM level required to maintain the inventory
DNC = number of components at the depot level required to maintain the inventory
CPU = number of times the component was removed during the operational period and ultimately repaired at AVIM level
CPI = number of times the component was removed during the operational period and ultimately repaired at the AVIM level
CPD = number of times the component was removed during the operational period and ultimately repaired at the depot level
HSU = number of total operating hours programmed during the unit repair cycle time (where cycle time covers the periods from removable to reinstallation of the item, based on FIFO processing).
HSI = number of total operating hours programmed during the intermediate repair cycle time
HSD = number of total operating hours programmed during the depot repair cycle time
HT = total utilization hours of platoon during operational test period

TABLE III. SAMPLE TABLE - SUBSYSTEM MAINTENANCE ACTION COSTS

	AVUM				AVIM		DEPOT		PART				
SUBSYSTEM	NO. ON A/C REPAIRS	NO. REMOVE/ REPLACE	NO. OFF A/C REPAIRS	TOTAL COST	NO. REPAIRS	TOTAL COST	NO. REPAIRS	TOTAL COST	NO. CONDEMN	SALVAGE VALUE	PIPELINE RCPL. COST	TOTAL COST	% OF TOTAL
1	X	X	X	$	X	$	X	$	X	-$	$	$	P
2	X	X	X	$	X	$	X	$	X	-$	$	$	P
3	X	X	X	$	X	$	X	$	X	-$	$	$	P
•	•	•	•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•	•	•	•
N	X	X	X	$	X	$	X	$	X	-$	$	$	P
TOTAL	X	X	X	$	X	$	X	$	X	-$	$	$	P
PERCENT				P		P		P			P	100%	

4.4 RMS Cost Summary

Table IV, RMS Cost Summary, presents an overview of the simulation. The previously determined direct inspection, indirect personnel, and maintenance total costs are expressed as costs per flight hour. These costs combined with the depreciation and flight costs, which are input, represent the total cost of ownership for the simulation period:

$$TDEP = HRF*IDR$$

$$TFLT = HRF*(CPF+CPC)$$

$$SYS = (TDEP+TFLT+TIN+TPR+TMN)/HRF$$

where

SYS = system cost
TDEP = total depreciation cost
TFLT = total flight cost
TIN = total inspection cost
TPR = total indirect labor cost
TMN = total maintenance cost
HRF = number of hours flown during the simulation
CPF = cost per flight hour (crew)
CPC = cost of consumables per flight hour
IDR = input depreciation rate based on the acquisition cost and expected number of flight hours

The simulation statistics listed in Table IV were determined independently of the cost:

UTP = (NAC*SIM-NORM-NORS)/(NAC*SIM)

MFMC = PMF/PMC

MCMF = PMCL/PMF

where

UTP = percentage of uptime/total time
NAC = number of A/C
SIM = simulation interval in hours
NORM = number of hours the platoon is not operationally ready - maintenance
NORS = number of hours the platoon is not operationally ready - supply
MFMC = percentage of missions flown/missions called
PMC = number of platoon missions called
PMF = number of platoon missions flown, including aborts
MCMF = percentage of missions completed/missions flown
PMCL = number of missions completed

TABLE IV. SAMPLE TABLE - RMS COST SUMMARY

	COST/FLIGHT HOUR	TOTAL COST	PERCENT
DEPRECIATION	X	X	P
FLIGHT	X	X	P
DIRECT INSPECTION	X	X	P
INDIRECT PERSONNEL	X	X	P
MAINTENANCE	X	X	P
SYSTEM	X	X	100.0

- SIMULATION PERIOD OF X DAYS
- TOTAL FLIGHT TIME OF X HOURS
- UPTIME / TOTAL TIME X
- MISSION FLOWN/MISSION CALLED X
- MISSION COMPLETED/MISSION FLOWN X

5. RMS COST DEMONSTRATION RESULTS

The RMS COST model software with several alternative maintenance systems was demonstrated on the IBM 360/65 computer system at AVSCOM. The AVSCOM R&M Division provided the helicopter system data, cost data, and maintenance system data input for each alternative. Technology Incorporated loaded the data for each execution into the computer and checked the output for proper functioning of the RMS COST model software.

The following sections describe the alternative maintenance systems and the resultant simulation output. In addition to the alternative maintenance systems, the final two runs were set up to demonstrate the variation in cost when the number of aircraft assigned to a company are reduced.

5.1 OH-58 Baseline Problem

AVSCOM selected a baseline problem that required simulating a 10-aircraft company flying 60 scheduled hours per week for a six-month period in the scenario of Figure 4.

Each OH-58 aircraft was represented as a system containing 106 components which were grouped into 10 subsystems. As listed in Table V, six time-change components were specified. The RMS model is designed to scrap all time-change components when they are removed at a periodic inspection because they reached their specified life-limit. AVSCOM prepared input failure rate data for each component on the basis of historical OH-58 maintenance information. The probability of a component failure being discovered during various events was as follows: preflight inspection, 0.000135; flight, 0.049; daily inspection, 0.030328; periodic inspection, 1.0. Given that a component failure was discovered during preflight, flight, or daily inspection, there was a very small chance (<0.025) that two or three failures would be discovered simultaneously. During the periodic inspection, however, at least 5 and as many as 35 failures were detected during each inspection with approximately 50% of the inspections detecting 17 or more failures. Given that a failure occurred, the input defined the probability of the involvement of each subsystem and each component. Approximately 16% of the failures were assigned to engine components and 64% to rotating components.

The RMS COST model also defines the manpower available in each MOS (Military Occupational Skill) category. The size of maintenance crew was so chosen that the model could respond to all missions called (see Table VI). AVSCOM provided the cost input data, which is illustrated in Figure 5.

SCENARIO SIMULATED FOR OH-58A RMS-COST DEMONSTRATION

ONE COMPANY OF 10 HELICOPTERS.

FLYING PROGRAM CONSISTS OF FIVE FLYING DAYS PER WEEK WITH THE SIMULATION INTERVAL COVERING 182 DAYS.

MISSION DURATION IS 1.0 HOUR

LAUNCH SCHEDULE DURING EACH FLYING DAY

0730	3 AIRCRAFT
0930	3 AIRCRAFT
1130	3 AIRCRAFT
1330	3 AIRCRAFT

STANDBY AIRCRAFT PREFLIGHTED AND READY AT ALL TIMES DURING THE SCHEDULED FLYING INTERVALS.

MISSION FLIGHT IS POSSIBLE UP TO 30 MINUTES AFTER SCHEDULED FLIGHT TIME. AFTER THIS INTERVAL, THE FLIGHT IS SCRUBBED.

MAINTENANCE CONCEPT SIMULATED

THE FIRST SHIFT LABOR IS SCHEDULED FROM 0700 TO 1500.
THE SECOND SHIFT LABOR IS SCHEDULED FROM 1500 TO 2300.
THE ONLY EXCEPTION TO THE ABOVE OCCURS WHEN THERE ARE NOT SUFFICIENT AIRCRAFT TO MEET THE FIRST MISSION DEMAND OF THE NEXT DAY.

DAILY INSPECTIONS ARE PERFORMED AT 24 HOUR INTERVALS DURING THE 5 WORKING DAYS.

PREVENTIVE MAINTENANCE PERIODIC (PMP) INSPECTIONS OCCUR AT 300 FLYING HOUR INTERVALS. ELAPSED TIME TO PERFORM A PMP IS 10 HOURS.

NO POST FLIGHT OR PREVENTIVE MAINTENANCE INTERMEDIATE (PMI) INSPECTIONS ARE PERFORMED.

THE AIRCRAFT HAVE 106 COMPONENTS WITHIN 10 SUBSYSTEMS.

OFF AIRCRAFT COMPONENT MAINTENANCE MAY BE PERFORMED AT THE AVUM, AVIM OR DEPOT LEVELS.

THERE ARE 6 TIME CHANGE COMPONENTS. THE 1 COMPONENT FROM THE ENGINE ASSEMBLY IS CHANGED AT 300 FLYING HOUR INTERVALS. THE FIVE COMPONENTS FROM THE ROTATIONAL COMPONENTS ARE CHANGED AT 1200 FLYING HOUR INTERVALS.

Figure 4. OH-58 Helicopter Baseline Scenario

TABLE V. OH-58 TIME-CHANGE COMPONENTS

Subsystem		Component		
Code	Description	Code	Description	Life (hr)
3	engine assembly	17	engine assembly	300
4	rotating components	32	swashplate support	1200
4	rotating components	36	main rotor blade	1200
4	rotating components	37	main rotor hub assy	1200
4	rotating components	45	mast	1200
4	rotating components	52	tail rotor drive shaft	1200

TABLE VI. MANPOWER ASSIGNMENT BY MOS

MOS	Function	1st Shift (men)	2nd Shift (men)
On A/C	On A/C repairs (primary work center)	4	2
Periodic MOS	Periodic insp. & AVUM off A/C repairs	3	0
Preflight	Preflight inspections	1	0
Daily MOS	Daily inspections	2	2
On A/C	On A/C repairs (secondary work center)	4	2

RMS COST DATA

AVUM MOS		AVERAGE HOURLY WAGE	AVERAGE HOURLY OVERHEAD RATE	CONSUMABLE RATE/EVENT	OVERTIME FACTOR
1	ON A/C MOS	11.63	0.0	0.0	1.5
2	OFF A/C MOS	11.63	0.0	0.0	1.5
3	PERIODIC MOS	11.63	0.0	0.0	1.5
4	PREFLIGHT	11.63	0.0	0.0	1.5
5	DAILY MOS	11.63	0.0	0.0	1.5
6	ON A/C MOS	11.63	0.0	0.0	1.5
7	AVUM MOS 7	11.63	0.0	0.0	1.5
8	AVUM MOS 8	11.63	0.0	0.0	1.5
9	AVUM MOS 9	11.63	0.0	0.0	1.5
10	AVUM MOS 10	11.63	0.0	0.0	1.5
11	AVUM MOS 11	11.63	0.0	0.0	1.5
12	AVUM MOS 12	11.63	0.0	0.0	1.5
13	AVUM MOS 13	11.63	0.0	0.0	1.5
14	AVUM MOS 14	11.63	0.0	0.0	1.5

AVIM MOS		AVERAGE HOURLY WAGE	AVERAGE HOURLY OVERHEAD RATE	CONSUMABLE RATE/EVENT
1	AVIM MOS 1	11.63	0.0	0.0
2	AVIM MOS 2	11.63	0.0	0.0
3	AVIM MOS 3	11.63	0.0	0.0
4	AVIM MOS 4	11.63	0.0	0.0
5	AVIM MOS 5	11.63	0.0	0.0
6	AVIM MOS 6	11.63	0.0	0.0
7	AVIM MOS 7	11.63	0.0	0.0
8	AVIM MOS 8	11.63	0.0	0.0
9	AVIM MOS 9	11.63	0.0	0.0
10	AVIM MOS 10	11.63	0.0	0.0
11	AVIM MOS 11	11.63	0.0	0.0
12	AVIM MOS 12	11.63	0.0	0.0

DEPOT MOS		AVERAGE HOURLY WAGE	AVERAGE HOURLY OVERHEAD RATE	CONSUMABLE RATE/EVENT
1	DEPOT MOS 1	11.63	0.0	0.0
2	DEPOT MOS 2	11.63	0.0	0.0
3	DEPOT MOS 3	11.63	0.0	0.0
4	DEPOT MOS 4	11.63	0.0	0.0
5	DEPOT MOS 5	11.63	0.0	0.0
6	DEPOT MOS 6	11.63	0.0	0.0
7	DEPOT MOS 7	11.63	0.0	0.0
8	DEPOT MOS 8	11.63	0.0	0.0
9	DEPOT MOS 9	11.63	0.0	0.0

Figure 5. OH-58 COST Input Data

SUBSYSTEM		NO. COMPONENTS
1	STRUCTURE	11
2	LANDING GEAR	3
3	ENGINE ASSY	15
4	ROTAT.COMPON	31
5	HYDRAUL SYS	4
6	INSTRUMENTS	10
7	ELECTRICAL	9
8	FUEL	4
9	FLT CONTROLS	7
10	NAV/COM COMP	12

COMPONENT	SUB-SYSTEM	COMPONENT COST	SALVAGE VALUE	TRANS. COST AVUM - AVIM	TRANS. COST AVIM - DEPOT	CONSUMABLE COST	AVUM CYCLE TIME	AVIM CYCLE TIME	DEPOT CYCLE TIME
1	1	664.00	199.20	0.0	0.0	0.0	71	71	71
2	1	140.00	42.00	0.0	0.0	0.0	111	111	111
3	1	18000.00	5400.00	0.0	0.0	0.0	63	63	63
4	1	313.00	93.90	0.0	0.0	0.0	91	91	91
5	1	562.00	168.60	0.0	0.0	0.0	59	59	59
6	1	658.00	197.40	0.0	0.0	0.0	59	59	59
7	1	75.00	22.50	0.0	0.0	0.0	61	61	61
8	1	389.00	116.70	0.0	0.0	0.0	65	65	65
9	1	410.00	123.00	0.0	0.0	0.0	63	63	63
10	1	809.00	242.70	0.0	0.0	0.0	85	85	85
11	1	1007.00	302.10	0.0	0.0	0.0	62	62	62
12	2	202.00	60.60	0.0	0.0	0.0	78	78	78
13	2	475.00	142.50	0.0	0.0	0.0	66	66	66
14	2	6.00	1.80	0.0	0.0	0.0	92	92	92
15	3	95.00	28.50	0.0	0.0	0.0	128	128	128
16	3	1210.00	363.00	0.0	0.0	0.0	104	104	104
17	3	17562.00	5268.60	0.0	0.0	0.0	63	63	63
18	3	7427.00	2228.10	0.0	0.0	0.0	62	62	62
19	3	450.00	135.00	0.0	0.0	0.0	62	62	62
20	3	3850.00	1155.00	0.0	0.0	0.0	103	103	103
21	3	4.50	1.35	0.0	0.0	0.0	90	90	90
22	3	50.00	15.00	0.0	0.0	0.0	66	66	66
23	3	770.00	231.00	0.0	0.0	0.0	81	81	81
24	3	440.00	132.00	0.0	0.0	0.0	66	66	66
25	3	1010.00	303.00	0.0	0.0	0.0	68	68	68
26	3	684.00	205.20	0.0	0.0	0.0	69	69	69
27	3	10.00	3.00	0.0	0.0	0.0	61	61	61
28	3	215.00	64.50	0.0	0.0	0.0	76	76	76
29	3	115.00	34.50	0.0	0.0	0.0	71	71	71
30	4	260.00	78.00	0.0	0.0	0.0	92	92	92
31	4	46.00	13.80	0.0	0.0	0.0	83	83	83
32	4	1310.00	373.00	0.0	0.0	0.0	88	88	88
33	4	45.00	13.50	0.0	0.0	0.0	58	58	58
34	4	78.00	23.40	0.0	0.0	0.0	65	65	65
35	4	120.00	36.00	0.0	0.0	0.0	58	58	58
36	4	2020.00	606.00	0.0	0.0	0.0	81	81	81
37	4	2550.00	765.00	0.0	0.0	0.0	69	69	69
38	4	20.00	6.00	0.0	0.0	0.0	83	83	83
39	4	50.00	15.00	0.0	0.0	0.0	86	86	86
40	4	7850.00	2355.00	0.0	0.0	0.0	138	138	138
41	4	11.00	3.30	0.0	0.0	0.0	69	69	69
42	4	366.00	109.00	0.0	0.0	0.0	133	133	133
43	4	20.00	6.00	0.0	0.0	0.0	71	71	71
44	4	1035.00	310.50	0.0	0.0	0.0	98	98	98
45	4	482.00	144.60	0.0	0.0	0.0	62	62	62
46	4	16.00	4.80	0.0	0.0	0.0	64	64	64
47	4	13.00	3.90	0.0	0.0	0.0	73	73	73
48	4	9.00	2.70	0.0	0.0	0.0	91	91	91
49	4	100.00	30.00	0.0	0.0	0.0	74	74	74
50	4	1350.00	405.00	0.0	0.0	0.0	138	138	138
51	4	20.00	6.00	0.0	0.0	0.0	128	128	128
52	4	230.00	69.00	0.0	0.0	0.0	58	58	58

Figure 5 - Continued

COMPONENT	SUB-SYSTEM	COMPONENT COST	SALVAGE VALUE	TRANS. COST AVUM - AVIM	TRANS. COST AVIM - DEPOT	CONSUMABLE COST	AVUM CYCLE TIME	AVIM CYCLE TIME	DEPOT CYCLE TIME
53	4	195.00	58.50	0.0	0.0	0.0	98	98	98
54	4	1.00	0.30	0.0	0.0	0.0	65	65	65
55	4	110.00	33.00	0.0	0.0	0.0	108	108	108
56	4	55.00	16.50	0.0	0.0	0.0	94	94	94
57	4	25.00	7.50	0.0	0.0	0.0	76	76	76
58	4	280.00	84.00	0.0	0.0	0.0	73	73	73
59	4	130.00	39.00	0.0	0.0	0.0	61	61	61
60	4	50.00	15.00	0.0	0.0	0.0	108	108	108
61	5	230.00	69.00	0.0	0.0	0.0	63	63	63
62	5	15.00	4.50	0.0	0.0	0.0	63	63	63
63	5	863.00	258.90	0.0	0.0	0.0	63	63	63
64	5	150.00	45.00	0.0	0.0	0.0	66	66	66
65	6	155.00	46.50	0.0	0.0	0.0	138	138	138
66	6	134.00	40.20	0.0	0.0	0.0	108	108	108
67	6	119.00	35.70	0.0	0.0	0.0	99	99	99
68	6	140.00	42.00	0.0	0.0	0.0	100	100	100
69	6	486.00	145.80	0.0	0.0	0.0	138	138	138
70	6	67.00	20.10	0.0	0.0	0.0	59	59	59
71	6	195.00	58.50	0.0	0.0	0.0	68	68	68
72	6	110.00	33.00	0.0	0.0	0.0	59	59	59
73	6	280.00	84.00	0.0	0.0	0.0	61	61	61
74	6	27.00	8.10	0.0	0.0	0.0	58	58	58
75	7	18.00	5.40	0.0	0.0	0.0	58	58	58
76	7	253.00	75.90	0.0	0.0	0.0	103	103	103
77	7	46.00	13.80	0.0	0.0	0.0	98	98	98
78	7	42.00	12.60	0.0	0.0	0.0	58	58	58
79	7	376.00	112.80	0.0	0.0	0.0	76	76	76
80	7	300.00	90.00	0.0	0.0	0.0	68	68	68
81	7	3.00	0.90	0.0	0.0	0.0	71	71	71
82	7	1.50	0.45	0.0	0.0	0.0	58	58	58
83	7	4.00	1.20	0.0	0.0	0.0	108	108	108
84	8	3.00	0.90	0.0	0.0	0.0	67	67	67
85	8	23.00	6.90	0.0	0.0	0.0	69	69	69
86	8	595.00	178.50	0.0	0.0	0.0	67	67	67
87	8	115.00	34.50	0.0	0.0	0.0	73	73	73
88	9	530.00	159.00	0.0	0.0	0.0	58	58	58
89	9	33.00	9.90	0.0	0.0	0.0	61	61	61
90	9	95.00	28.50	0.0	0.0	0.0	81	81	81
91	9	110.00	33.00	0.0	0.0	0.0	65	65	65
92	9	116.00	34.80	0.0	0.0	0.0	70	70	70
93	9	120.00	36.00	0.0	0.0	0.0	71	71	71
94	9	834.00	250.20	0.0	0.0	0.0	73	73	73
95	10	263.00	78.90	0.0	0.0	0.0	68	68	68
96	10	2625.00	787.50	0.0	0.0	0.0	88	88	88
97	10	200.00	60.00	0.0	0.0	0.0	88	88	88
98	10	550.00	165.00	0.0	0.0	0.0	60	60	60
99	10	2080.00	624.00	0.0	0.0	0.0	88	88	88
100	10	3150.00	945.00	0.0	0.0	0.0	60	60	60
101	10	3413.00	102.39	0.0	0.0	0.0	73	73	73
102	10	2783.00	834.90	0.0	0.0	0.0	68	68	68
103	10	4200.00	126.00	0.0	0.0	0.0	77	77	77
104	10	4250.00	127.50	0.0	0.0	0.0	73	73	73
105	10	800.00	24.00	0.0	0.0	0.0	108	108	108
106	10	7800.00	2340.00	0.0	0.0	0.0	60	60	60

DEPRECIATION RATE PER FLIGHT HOUR 15.78

FLIGHT COST PER FLIGHT HOUR 20.00

CONSUMABLE COST PER FLIGHT HOUR 10.00

Figure 5 - Concluded

The results of the simulation for the baseline problem are presented in Figure 6. The output comprises five parts: Basic R&M RMS Output (Figure 6-a), RMS Inspection Cost (Figure 6-b), Inspection and Unscheduled Maintenance Personnel Costs (Figure 6-c), Subsystem Maintenance Action Cost (Figure 6-d), and RMS Cost Summary (Figure 6-e).

In Figure 6-a, the 182-day simulation produced 1572.5 flying hours of which 1549 were completed missions. The mission reliability (missions completed/missions flown) was 99.29 percent. The operational availability (uptime/total time) was 86.51 percent. The system MTBF was 10.99 hours, and the mean time between maintenance was 10.77 hours. For each flight hour, 1.72 man-hours on the average were spent at the unit level for preventive maintenance and 6.09 man-hours on the average from all levels combined were spent for corrective maintenance. All data in this table came from the basic RMS model and do not depend on any of the cost logic or input data.

The first of the cost model printouts, Figure 6-b, gives the total inspection cost. Of the $24,809 spent for manpower and consumables used during inspections, 81 percent was for daily inspections.

The second of the cost model printouts, Figure 6-c, summarizes the unit maintenance personnel costs by MOS category. Since the titles for the MOS levels were selected arbitrarily, they are not completely descriptive (for instance, the "Periodic MOS" personnel perform not only the periodic inspections but also the AVUM off-aircraft component repairs). A total of $241,904 was required to support the unit personnel for 6 months. The 80.53 percent spent for indirect labor represents only the time the maintenance personnel were not actively working and does not include support and management functions. These latter "overhead" costs were introduced through the man-hour rate applied.

Figure 6-d presents maintenance repair and pipeline costs with a breakdown by subsystem and by organizational level. Of the total $170,199 in this figure, approximately 62 percent was spent on the engine assembly and another 37 percent was spent on the rotating components. The breakdown of maintenance costs by organizational level was 13 percent for AVUM, 3 percent for AVIM, 53 percent for depot, and 31 percent to maintain the pipeline.

The RMS Cost Summary printout, Figure 6-e, includes the total operation and maintenance costs for the baseline problem. As shown, the total system cost was $461,577 or $293.53 per flight hour.

R&M DIVISION, PRODUCT ASSURANCE DIRECTORATE

R & M SIMULATION (RMS) MODEL

AIRCRAFT STATISTICS

TOTAL FLYING HOURS	1572.5
FLYING HOURS - COMPLETED MISSIONS	1549.0
FLYING HOURS - ABORTED MISSIONS	5.5
FLYING HOURS - TEST HOPS	18.0
MISSION RELIABILITY	99.29
SYSTEM MTBF	10.99
INHERENT AVAILABILITY	97.50
ACHIEVED AVAILABILITY	86.56
OPERATIONAL AVAILABILITY	86.51
MEAN TIME BETWEEN MAINTENANCE	10.77
MEAN TIME TO REPAIR	3.33
AVUM PREVENTIVE MMH/FH (INSPECTIONS & SERVICING)	1.72
AVUM SCHEDULED MMH/FH (INSPECTIONS & TBO'S)	1.72
AVUM CORRECTIVE MMH/FH	.85
AVUM & INTERMEDIATE CORRECTIVE MMH/FH	1.15
INTERMEDIATE CORRECTIVE MMH/FH	.30
DEPOT CORRECTIVE MMH/FH	4.94
TOTAL CORRECTIVE MMH/FH	6.09

a. Basic RMS Output

Figure 6. RMS COST Model Output - OH-58 Baseline Problem

RMS INSPECTION COST

MOS LEVEL	PREFLIGHT	POST FLIGHT	DAILY	INTERMEDIATE	PERIODIC	TOTAL	PERCENT
PERIODIC MOS	0.	0.	0.	0.	1047.	1047.	4.22
PREFLIGHT	3670.	0.	0.	0.	0.	3670.	14.79
DAILY MOS	0.	0.	20092.	0.	0.	20092.	80.99
TOTAL	3670.	0.	20092.	0.	1047.	24809.	100.00
PERCENT OF TOTAL	14.79	0.0	80.99	0.0	4.22	100.00	

b. RMS Inspection Cost

Figure 6 - Continued

INSPECTION AND UNSCHEDULED MAINTENANCE PERSONNEL COSTS

MOS LEVEL	DIRECT REGULAR	DIRECT OVERTIME	INDIRECT	TOTAL	PERCENT
ON A/C MOS	10804.	0.	61767.	72571.	30.00
PERIODIC MOS	1719.	0.	34567.	36286.	15.00
PREFLIGHT	3670.	0.	8425.	12095.	5.00
DAILY MOS	20092.	0.	28289.	48381.	20.00
ON A/C MOS	10804.	0.	61767.	72571.	30.00
TOTAL	47089.	0.	194815.	241904.	100.00
PERCENT OF TOTAL	19.47	0.0	80.53	100.00	

c. Inspection and Unscheduled Maintenance Personnel Costs

Figure 6 - Continued

SUBSYSTEM MAINTENANCE ACTION

SUBSYSTEM	AVUM NO. OF ON-EQUIP REPAIRS	AVUM NO. OF REMOVE REPLACE	AVUM NO. OF OFF-EQUIP REPAIRS	AVUM TOTAL COST	AVIM NO. OF REPAIRS	AVIM TOTAL COST	DEPOT NO. OF REPAIRS	DEPOT TOTAL COST	PART NO. OF CONDEMN	PART SALVAGE VALUE	PART PIPELINE REPL. COST	TOTAL COST	PERCENT OF TOTAL
STRUCTURE	1	1	1	370.	0	0.	0	0.	0	0.	0.	370.	0.22
LANDING GEAR	0	2	2	288.	0	0.	0	0.	0	0.	0.	288.	0.17
ENGINE ASSY	15	24	10	6865.	4	533.	6	61047.	3	-15806.	52686.	105325.	61.88
ROTAT.COMPON	14	77	12	13986.	13	4999.	23	29454.	23	-6217.	20722.	62944.	36.98
INSTRUMENTS	1	0	0	49.	0	0.	0	0.	0	0.	0.	49.	0.03
ELECTRICAL	2	5	3	397.	1	12.	0	0.	1	-1.	3.	411.	0.24
FUEL	1	0	0	7.	0	0.	0	0.	0	0.	0.	7.	0.00
FLT CONTROLS	2	5	2	270.	1	5.	0	0.	2	-194.	646.	727.	0.43
NAV/COM COMP	2	2	0	49.	2	29.	0	0.	0	0.	0.	78.	0.05
TOTAL	38	116	30	22281.	21	5578.	29	90501.	29	-22218.	74057.	170199.	100.00
PERCENT OF TOTAL				13.09		3.28		53.17			30.46	100.00	

d. Subsystem Maintenance Action Cost

Figure 6 - Continued

RMS COST SUMMARY

	COST/FLIGHT HOUR	TOTAL COST	PERCENT
DEPRECIATION	15.78	24814.	5.38
FLIGHT	29.85	46940.	10.17
DIRECT INSPECTION	15.78	24809.	5.37
INDIRECT PERSONNEL	123.89	194815.	42.21
MAINTENANCE	108.23	170199.	36.87
SYSTEM	293.53	461577.	100.00

TOTAL SIMULATION TIME (DAYS)	182.0
TOTAL FLIGHT TIME (HRS)	1572.5
UPTIME/TOTAL TIME	86.51
MISSIONS FLOWN/MISSIONS CALLED	100.00
MISSIONS COMPLETED/MISSIONS FLOWN	99.29

e. RMS Cost Summary

Figure 6 - Concluded

5.2 Failure Rate Alternatives

The first two OH-58 alternative problems were formed by multiplying the baseline failure rate by 1.2 and by 0.8. Figure 7 compares the output results with these two alternatives. The complete set of the printouts for the alternatives are included in the Appendix.

AIRCRAFT STATISTICS	FAILURE RATE BASELINE	FAILURE RATE 1.2(BASELINE)	FAILURE RATE 0.8(BASELINE)
TOTAL FLYING HOURS	1572.5	1563.5	1562.5
FLYING HOURS - COMPLETED MISSIONS	1549.0	1529.0	1539.0
FLYING HOURS - ABORTED MISSIONS	5.5	15.5	10.5
FLYING HOURS - TEST HOPS	18.0	19.0	13.0
MISSION RELIABILITY	99.29	98.01	98.65
SYSTEM MTBF	10.9[illegible]	6.10	10.41
INHERENT AVAILABILITY	97.50	91.97	97.27
ACHIEVED AVAILABILITY	86.56	82.08	86.85
OPERATIONAL AVAILABILITY	86.51	82.08	86.85
MEAN TIME BETWEEN MAINTENANCE	10.77	5.9[illegible]	10.14
MEAN TIME TO REPAIR	3.33	3.54	4.34
AVUM PREVENTIVE MMH/FH (INSPECTIONS & SERVICING)	1.72	1.80	1.72
AVUM SCHEDULED MMH/FH (INSPECTIONS & TBO'S)	1.72	1.74	1.72
AVUM CORRECTIVE MMH/FH	.85	1.91	1.44
AVUM & INTERMEDIATE CORRECTIVE MMH/FH	1.15	2.36	1.82
INTERMEDIATE CORRECTIVE MMH/FH	.30	.45	.38
DEPOT CORRECTIVE MMH/FH	4.94	14.68	5.55
TOTAL CORRECTIVE MMH/FH	6.09	17.04	7.37

a. Basic RMS Output

	FAILURE RATE BASELINE COST/FLIGHT HOUR	FAILURE RATE 1.2(BASELINE) COST/FLIGHT HOUR	FAILURE RATE 0.8(BASELINE) COST/FLIGHT HOUR
DEPRECIATION	15.78	15.78	15.78
FLIGHT	29.85	29.76	29.85
DIRECT INSPECTION	15.78	15.36	15.86
INDIRECT PERSONNEL	123.89	112.28	118.01
MAINTENANCE	108.23	255.42	125.65
SYSTEM	293.53	428.63	305.15
TOTAL SIMULATION TIME (DAYS)	182.0	182.0	182.0
TOTAL FLIGHT TIME (HRS)	1572.5	1563.5	1562.5
UPTIME/TOTAL TIME	86.51	82.08	86.85
MISSIONS FLOWN/MISSIONS CALLED	100.00	100.00	100.00
MISSIONS COMPLETED/MISSIONS FLOWN	99.29	98.01	98.65

b. RMS Cost Summary

Figure 7. Comparison of RMS COST Model Results - Failure Rate Alternatives

With ten aircraft available to respond to the mission calls for three at a time, the failure rates had little effect on flight hours or on aircraft availability or reliability. The system MTBF decreased significantly from the baseline when the system failure rate was increased to 120 percent, but it did not change significantly when the failure rate was reduced to 80 percent. The inconsistency of the results for the problem with the 80 percent failure rate was traced to randomly generated initial airframe hours which caused the aircraft with the 80 percent failure rates to undergo four periodic inspections with the attendant unscheduled corrective maintenance while the aircraft with the baseline failure rates required only three periodic inspections. This 25 percent increase in periodic inspections and component maintenance action nullified the effects of the 80 percent reduction in failure rate.

The costs for the failure rate alternatives are compared in Figure 7-b. The problem with the increased failure rate indicated a system cost of $428.63 per flight hour compared with the $293.53 per flight hour for the baseline problem. As explained above, the execution of the problem with the reduced failure rate did not evidence the expected decrease in cost; but at $305.15 per flight hour, the cost was a little higher than the baseline cost because of the maintenance cost.

5.3 Manpower Alternatives

The second two OH-58 alternative problems were derived from the baseline failure rate by modifying the manpower loading as shown in Table VII.

TABLE VII. MANPOWER ALTERNATIVES

	No. of Men (1st Shift/2nd Shift)		
MOS Level	20-men Baseline	20-men Alternative	36-men Alternative
On A/C (Primary)	4/2	6/2	6/6
Periodic MOS	3/0	3/0	3/3
Preflight	1/0	1/0	1/1
Daily MOS	2/2	2/0	2/2
On A/C (Secondary)	4/2	4/2	6/6

The outputs of the manpower loading alternatives are compared in Figure 8. The complete set of the printouts for these alternatives is included in the Appendix.

AIRCRAFT STATISTICS	20-MEN BASELINE	20-MEN ALTERNATIVE	36-MEN ALTERNATIVE
TOTAL FLYING HOURS	1572.5	1334.5	1568.0
FLYING HOURS - COMPLETED MISSIONS	1549.0	1307.0	1528.0
FLYING HOURS - ABORTED MISSIONS	5.5	4.5	16.0
FLYING HOURS - TEST HOPS	18.0	23.0	24.0
MISSION RELIABILITY	99.29	99.31	97.94
SYSTEM MTBF	10.99	11.70	6.81
INHERENT AVAILABILITY	97.50	97.96	97.51
ACHIEVED AVAILABILITY	86.56	18.76	86.84
OPERATIONAL AVAILABILITY	86.51	18.76	86.84
MEAN TIME BETWEEN MAINTENANCE	10.77	11.60	6.67
MEAN TIME TO REPAIR	3.33	3.61	3.99
AVUM PREVENTIVE MMH/FH (INSPECTIONS & SERVICING)	1.72	1.62	2.13
AVUM SCHEDULED MMH/FH (INSPECTIONS & TBO'S)	1.72	1.62	2.07
AVUM CORRECTIVE MMH/FH	.85	1.13	2.04
AVUM & INTERMEDIATE CORRECTIVE MMH/FH	1.15	1.36	2.57
INTERMEDIATE CORRECTIVE MMH/FH	.30	.23	.53
DEPOT CORRECTIVE MMH/FH	4.94	6.11	8.42
TOTAL CORRECTIVE MMH/FH	6.09	7.47	10.99

a. Basic RMS Output

	20-MEN BASELINE COST/FLIGHT HOUR	20-MEN ALTERNATIVE COST/FLIGHT HOUR	36-MEN ALTERNATIVE COST/FLIGHT HOUR
DEPRECIATION	15.78	15.78	15.78
FLIGHT	29.85	29.74	29.74
DIRECT INSPECTION	15.78	17.68	16.20
INDIRECT PERSONNEL	123.89	150.49	229.73
MAINTENANCE	108.23	111.88	198.50
SYSTEM	293.53	325.63	489.96
TOTAL SIMULATION TIME (DAYS)	182.0	182.0	182.0
TOTAL FLIGHT TIME (HRS)	1572.5	1334.5	1568.0
UPTIME/TOTAL TIME	86.51	18.76	86.84
MISSIONS FLOWN/MISSIONS CALLED	100.00	84.35	100.00
MISSIONS COMPLETED/MISSIONS FLOWN	99.29	99.31	97.94

b. RMS Cost Summary

Figure 8. Comparison of RMS COST Model Results - Manpower Loading Alternatives

Two interesting results shown in Figure 8-a are the very low operational availability (18.76 percent) for the 20-men alternative and the relatively low system MTBF (6.81 hr) and mean time between maintenance (6.67 hr) for the 36-men alternative. The first result was due to a backup of aircraft awaiting daily inspection because the second shift of "Daily MOS" was not used on the 20-men alternative. The second result was caused by an increase in the number of component failures found because five periodic inspections were performed for the 36-men alternative while only three periodic inspections were performed for the baseline problem.

In Figure 8-b, the costs for the manpower loading alternatives have an orderly progression from $293.53 per flight hour for the 20-men baseline to $325.63 per flight hour for the 20-men alternative and to $489.96 per flight hour for the 36-men alternative. In each case, the costs were dominated by the indirect costs of inactive personnel.

Although the minimum number and optimum distribution of maintenance personnel in the various MOS levels could likely be determined, this was not attempted. These variables can be optimized on system cost and missions flown/missions called.

5.4 Fleet Size Alternatives

The baseline 10-aircraft fleet was replaced by 4-aircraft and 3-aircraft fleets to form two alternative problems. The complete set of the printouts for these alternatives is included in the Appendix. Figure 9 summarizes the results of the alternatives.

AIRCRAFT STATISTICS	10-A/C BASELINE	4-A/C ALTERNATIVE	3-A/C ALTERNATIVE
TOTAL FLYING HOURS	1572.5	1468.5	1433.0
FLYING HOURS - COMPLETED MISSIONS	1549.0	1445.0	1409.0
FLYING HOURS - ABORTED MISSIONS	5.5	9.5	12.0
FLYING HOURS - TEST HOPS	18.0	14.0	12.0
MISSION RELIABILITY	99.29	98.70	98.32
SYSTEM MTBF	10.99	9.59	10.02
INHERENT AVAILABILITY	97.50	88.03	92.35
ACHIEVED AVAILABILITY	86.56	82.98	88.07
OPERATIONAL AVAILABILITY	86.51	82.95	87.90
MEAN TIME BETWEEN MAINTENANCE	10.77	9.35	9.74
MEAN TIME TO REPAIR	3.33	4.36	3.13
AVUM PREVENTIVE MMH/FH (INSPECTIONS & SERVICING)	1.72	1.30	.95
AVUM SCHEDULED MMH/FH (INSPECTIONS & TBO'S)	1.72	1.24	.88
AVUM CORRECTIVE MMH/FH	.85	1.57	1.12
AVUM & INTERMEDIATE CORRECTIVE MMH/FH	1.15	1.73	1.53
INTERMEDIATE CORRECTIVE MMH/FH	.30	.16	.41
DEPOT CORRECTIVE MMH/FH	4.94	7.74	1.49
TOTAL CORRECTIVE MMH/FH	6.09	9.47	3.02

a. Basic RMS Output

Figure 9. Comparison of RMS COST Model Results - Fleet Size Alteratives

	10-A/C BASELINE COST/FLIGHT HOUR	4-A/C ALTERNATIVE COST/FLIGHT HOUR	3-A/C ALTERNATIVE COST/FLIGHT HOUR
DEPRECIATION	15.78	15.78	15.78
FLIGHT	29.85	29.84	29.83
DIRECT INSPECTION	15.78	8.13	7.16
INDIRECT PERSONNEL	123.89	133.67	146.13
MAINTENANCE	108.23	163.83	92.06
SYSTEM	293.53	351.24	290.97
TOTAL SIMULATION TIME (DAYS)	182.0	182.0	182.0
TOTAL FLIGHT TIME (HRS)	1572.5	1468.5	1433.0
UPTIME/TOTAL TIME	86.51	82.95	87.90
MISSIONS FLOWN/MISSIONS CALLED	100.00	93.84	91.85
MISSIONS COMPLETED/MISSIONS FLOWN	99.29	98.70	98.32

b. RMS Cost Summary

Figure 9 - Concluded

The comparison of the flying hours in Figure 9-a shows that the reduced fleets are unable to respond to some mission calls. The system MTBF's, however, are roughly equal for the 3-aircraft, 4-aircraft, and 10-aircraft fleets. The depot-level corrective maintenance man-hours per flight hour for the 3-aircraft alternative are unusually low when compared with the baseline and 4-aircraft alternative. These low man-hours were due to an extremely short time to repair for two of the three engine assembly components sent to depot. The time to repair was computed from an input value for man-hours on a random number drawn from an exponential distribution.

The cost comparison in Figure 9-b shows a reduction in the direct inspection costs per flight hour for the smaller fleets because fewer daily inspections are required for the same total flight time. Of course, there is an offsetting increase in the indirect personnel costs per flight hour. The maintenance cost per flight hour is lowest for the 3-aircraft fleet because of the low cost of the depot-level maintenance, as described above. As expected, the 3-aircraft fleet had a higher operational availability (uptime/total time) than the 10-aircraft fleet since the smaller fleet had the same number of maintenance men available as the larger fleet.

6. CONCLUSIONS

(1) The revised RMS COST model produced satisfactory results with and without the optional cost computations.

(2) The RMS COST model has proved capable of evaluating the costs of maintenance system alternatives.

(3) Because of the random initial assignment of aircraft times to the next periodic inspection and the random selection of aircraft called from the ready pool by the basic RMS model, the computed system MTBF and costs are often unpredictable.

(4) The input data used for OH-58 time-change components was not considered realistic because the basic RMS model always scraps a component when it reaches TBO. The component cost should have accounted for a mix of new and overhauled components.

7. RECOMMENDATIONS

(1) The R&M Division should develop complete documentation (including the basic RMS logic) for a standardized RMS COST model. The model configuration should be carefully controlled with all changes properly documented. The output should be redesigned to provide an automatic descriptive scenario output and a more readable format of some of the standard GPSS tables.

(2) For a more realistic simulation of fleet maintenance, the periodic inspections (within the RMS logic) should be scheduled on a regular basis according to total fleet usage. In addition, individual aircraft usage should be adjusted by using high-time aircraft for standby until they are scheduled for inspection or by some other method of setting priorities such that aircraft are called from the ready pool on the basis of their projected scheduled maintenance requirements.

(3) The model should have an option to permit cost and reliability sensitivity studies by executing the same simulation several times while varying only one parameter.

(4) The model should be modified to track costs of components with a warranty. This will require changes in the basic RMS model to store hours on individual components and to condemn (return to vendor) all components which fail under warranty. In addition, the cost logic will require changes to accept the cost terms of typical warranty arrangements.

REFERENCES

1. Kirchmer, J.E., RMS COST Model User's Manual, AVSCOM Technical Report 75-28, R&M Division, Directorate for Product Assurance, U.S. Army Aviation Systems Command, St. Louis, Missouri, June 1975.

2. Reliability and Maintainability Planning Guide for Army Aviation Systems and Components, AVSCOM Pamphlet No. 702, R&M Division, Directorate for Product Assurance, U.S. Army Aviation Systems Command, St. Louis, Missouri, July 1974.

3. Weapon/Support Systems Cost Categories and Elements, Army Regulation No. AR 37-18, Headquarters Department of the Army, Washington, D.C., October 1971.

4. Peake, J.E., Development of a Reliability and Maintainability Analysis Technique for Helicopter Research and Development, USAAMRDL Technical Report 73-75 (AD 772955), Eustis Directorate, Fort Eustis, Virginia, October 1973.

5. Life Cycle Costing Guide for System Acquisitions (Interim), Department of Defense LCC-3, January 1973.

BIBLIOGRAPHY

1. A Generalized Life Cycle Cost Model for Electronic Equipment, AD 719 709, Booz-Allen Applied Research, Inc., U.S. Army Electronics Command, Ft. Monmouth, New Jersey, 12 March 1970.

2. Army Materiel Maintenance Concepts and Policies, AR 750-1, Headquarters, Department of the Army, May 1972.

3. Batchelder, C.A., et al, An Introduction to Equipment Cost Estimating, AD 702 424, The Rand Corporation, Santa Monica, California, December 1969.

4. Boyd, A.T., An Introduction to Systems Cost Modeling, N72-30982, Elliott-Automation Space and Advanced Military, May 1972.

5. Casebook Life Cycle Costing in Equipment Procurement, LCC-2, Department of Defense, Washington, DC, July 1970.

6. Dougherty, J.J., III, CH-47C/HLH R&M Simulation Analysis, USAAMRDL-TR-74-9, Boeing Vertol Company, Philadelphia, Pennsylvania, July 1974.

7. Engineering Design Handbook, Systems Analysis and Cost-Effectiveness, AD 884 151, Headquarters, U.S. Army Materiel Command (AMCRD-TV), Washington, DC, April 1971.

8. Goldman, A.S., Problems in Life Cycle Support Cost Estimation, from Naval Research Logistics Quarterly, Vol 16 No. 1, AD 685 586, General Electric Company, March 1969.

9. Hamilton, J.L., Life Cycle Cost Modeling, AD 684 335, Systems and Cost Analysis Division, U.S. Army Materiel Command, Washington, DC, December 1968.

10. Handbook of Systems Effectiveness Models, AD 749 924, Research Triangle Institute, Naval Electronics Laboratory Center, San Diego, California, 30 June 1972.

11. Kassos, A.G., Jr., A Computer Model for Aircraft PIP and ECP Economic Analysis, USAAVSCOM Technical Report 73-5, Cost Analysis Division, St. Louis, Missouri, March 1973.

12. Katz, I., Capt. R. E. Cavender, Weapon Systems Life Cycle Costing, AD 729 866, Air Force Logistics Command, Wright-Patterson Air Force Base, July 1971.

13. Life Cycle Costing Guide for System Acquisition (Interim), LCC-3, Department of Defense, Washington, DC, January 1973.

14. Life Cycle Costing Procurement Guide (Interim), LCC-1, Department of Defense, Washington, DC, July 1970.

BIBLIOGRAPHY (Concluded)

15. Life Cycle Cost/System Effectiveness Evaluation and Criteria, AD 91600, The Boeing Company, Seattle, Washington, 7 January 1974.

16. Manpower and Equipment Control Organization and Equipment Authorization Tables - Personnel, AR 570-2, Headquarters, U.S. Army Materiel Command, Washington, DC, 28 September 1970.

17. McGarrahan, J.R., Comparative Cost-Effectiveness Analyses at a Naval Air Rework Facility, AD 769 377, Naval Postgraduate School, Monterey, California, September 1973.

18. Methods of Estimating Fixed-Wing Airframe Costs, Vol. I (Revised), AD 817 670, Planning Research Corporation, Los Angeles, California, Office of the Secretary of Defense, April 1967.

19. Mitchell, H.A., Program for Automated Cost Estimating (PACE), AD 892 517, Cost Analysis Division, U.S. Army Missile Command, Redstone Arsenal, Alabama, 15 June 1971.

20. Newman, R.G., Directorate of Systems and Cost Analysis Overhaul Facility Simulator, AD 730 337, Army Aviation Systems Command, St. Louis, Missouri, July 1971.

21. O'Flaherty, J., Weapon System Cost Model Objectives, AD 883 277, Research Analysis Corporation, McLean, Virginia 22101, April 1971.

22. Peake, J.E., Development of a Reliability and Maintainability Analysis Technique for Helicopter Research and Development, USAAMRDL Technical Report 73-75, Eustis Directorate, Fort Eustis, Virginia, October 1973.

23. Phillips, J.G., Costs of Operation and Maintenance Activities (Army): Techniques for Analysis and Estimate, AD 664 748, Research Analysis Corporation, McLean, Virginia, January 1968.

24. Reliability and Maintainability Planning Guide for Army Aviation Systems and Components, AVSCOM Pamphlet No. 702-, R&M Division, Directorate for Product Assurance, St. Louis, Missouri, July 1974.

25. Stament, A.D., et al, Cost Estimating Relationships: A Manual for the Army Materiel Command, AD 742 810, Research Analysis Corporation, McLean, Virginia, May 1972.

26. Weapon/Support Systems Cost Categories and Elements, AR 37-18, Headquarters, Department of the Army, Washington, DC, 15 October 1971.

APPENDIX

RMS COST MODEL OUTPUTS
FOR OH-58 ALTERNATIVES

R&M DIVISION, PRODUCT ASSURANCE DIRECTORATE

R & M SIMULATION (RMS) MODEL

AIRCRAFT STATISTICS

TOTAL FLYING HOURS	1563.5
FLYING HOURS - COMPLETED MISSIONS	1529.0
FLYING HOURS - ABORTED MISSIONS	15.5
FLYING HOURS - TEST HOPS	19.0
MISSION RELIABILITY	98.01
SYSTEM MTBF	6.10
INHERENT AVAILABILITY	91.97
ACHIEVED AVAILABILITY	82.08
OPERATIONAL AVAILABILITY	82.08
MEAN TIME BETWEEN MAINTENANCE	5.99
MEAN TIME TO REPAIR	3.54
AVUM PREVENTIVE MMH/FH (INSPECTIONS & SERVICING)	1.80
AVUM SCHEDULED MMH/FH (INSPECTIONS & TBO'S)	1.74
AVUM CORRECTIVE MMH/FH	1.91
AVUM & INTERMEDIATE CORRECTIVE MMH/FH	2.36
INTERMEDIATE CORRECTIVE MMH/FH	.45
DEPOT CORRECTIVE MMH/FH	14.68
TOTAL CORRECTIVE MMH/FH	17.04

a. Basic RMS Output

Figure 10. RMS COST Model Output - OH-58 with 120% Failures Rates

RMS INSPECTION COST

MOS LEVEL	PREFLIGHT	POST FLIGHT	DAILY	INTERMEDIATE	PERIODIC	TOTAL	PERCENT
PERIODIC MOS	0.	0.	0.	0.	1396.	1396.	5.81
PREFLIGHT	3673.	0.	0.	0.	0.	3673.	15.29
DAILY MOS	0.	0.	18952.	0.	0.	18952.	78.90
TOTAL	3673.	0.	18952.	0.	1396.	24021.	100.00
PERCENT OF TOTAL	15.29	0.0	78.90	0.0	5.81	100.00	

b. RMS Inspection Cost

Figure 10 - Continued

INSPECTION AND UNSCHEDULED MAINTENANCE PERSONNEL COSTS

MOS LEVEL	DIRECT REGULAR	DIRECT OVERTIME	INDIRECT	TOTAL	PERCENT
ON A/C MOS	20632.	0.	51940.	72572.	30.00
PERIODIC MOS	2460.	0.	33826.	36286.	15.00
PREFLIGHT	3673.	0.	8422.	12095.	5.00
DAILY MOS	18952.	0.	29429.	48381.	20.00
ON A/C MOS	20632.	0.	51940.	72572.	30.00
TOTAL	66349.	0.	175557.	241906.	100.00
PERCENT OF TOTAL	27.43	0.0	72.57	100.00	

c. Inspection and Unscheduled Maintenance Personnel Costs

Figure 10 - Continued

SUBSYSTEM MAINTENANCE ACTION

SUBSYSTEM	AVUM NO. OF ON-EQUIP REPAIRS	AVUM NO. OF REMOVE REPLACE	AVUM NO. OF OFF-EQUIP REPAIRS	AVUM TOTAL COST	AVIM NO. OF REPAIRS	AVIM TOTAL COST	DEPOT NO. OF REPAIRS	DEPOT TOTAL COST	PART NO. OF CONDEMN	PART SALVAGE VALUE	PART PIPELINE REPL. COST	TOTAL COST	PERCENT OF TOTAL
STRUCTURE	6	4	2	1529.	2	578.	0	0.	0	0.	0.	2107.	0.53
ENGINE ASSY	18	41	7	18216.	4	656.	21	234365.	5	-26343.	87810.	314704.	78.80
ROTAT.COMPON	18	139	19	20648.	30	6964.	41	32687.	37	-8171.	27238.	79366.	19.87
HYDRAUL SYS	2	0	0	154.	0	0.	0	0.	0	0.	0.	154.	0.04
INSTRUMENTS	3	8	2	273.	0	0.	0	0.	6	-467.	1556.	1362.	0.34
ELECTRICAL	3	10	9	679.	0	0.	0	0.	1	-5.	18.	692.	0.17
FUEL	2	0	0	35.	0	0.	0	0.	0	0.	0.	35.	0.01
FLT CONTROLS	2	1	0	121.	0	0.	0	0.	1	-35.	116.	202.	0.05
NAV/COM COMP	7	5	1	672.	4	55.	0	0.	0	0.	0.	727.	0.18
TOTAL	61	206	40	42327.	40	8253.	62	267052.	50	-35021.	116738.	399349.	100.00
PERCENT OF TOTAL				10.60		2.07		66.87			20.46	100.00	

d. Subsystem Maintenance Action Cost

Figure 10 - Continued

RMS COST SUMMARY

	COST/FLIGHT HOUR	TOTAL COST	PERCENT
DEPRECIATION	15.78	24672.	3.68
FLIGHT	29.78	46560.	6.95
DIRECT INSPECTION	15.36	24021.	3.58
INDIRECT PERSONNEL	112.28	175557.	26.20
MAINTENANCE	255.42	399349.	59.59
SYSTEM	428.63	670159.	100.00

TOTAL SIMULATION TIME (DAYS)	182.0
TOTAL FLIGHT TIME (HRS)	1563.5
UPTIME/TOTAL TIME	82.08
MISSIONS FLOWN/MISSIONS CALLED	100.00
MISSIONS COMPLETED/MISSIONS FLOWN	98.01

e. RMS Cost Summary

Figure 10 - Concluded

R&M DIVISION, PRODUCT ASSURANCE DIRECTORATE

R & M SIMULATION (RMS) MODEL

AIRCRAFT STATISTICS

TOTAL FLYING HOURS	1562.5
FLYING HOURS - COMPLETED MISSIONS	1539.0
FLYING HOURS - ABORTED MISSIONS	10.5
FLYING HOURS - TEST HOPS	13.0
MISSION RELIABILITY	98.65
SYSTEM MTBF	10.41
INHERENT AVAILABILITY	97.27
ACHIEVED AVAILABILITY	86.85
OPERATIONAL AVAILABILITY	86.85
MEAN TIME BETWEEN MAINTENANCE	10.14
MEAN TIME TO REPAIR	4.34
AVUM PREVENTIVE MMH/FH (INSPECTIONS & SERVICING)	1.72
AVUM SCHEDULED MMH/FH (INSPECTIONS & TBO'S)	1.72
AVUM CORRECTIVE MMH/FH	1.44
AVUM & INTERMEDIATE CORRECTIVE MMH/FH	1.82
INTERMEDIATE CORRECTIVE MMH/FH	.38
DEPOT CORRECTIVE MMH/FH	5.55
TOTAL CORRECTIVE MMH/FH	7.37

a. Basic RMS Output

Figure 11. RMS COST Model Output - OH-58 with 80% Failure Rates

RMS INSPECTION COST

MOS LEVEL	PREFLIGHT	POST FLIGHT	DAILY	INTERMEDIATE	PERIODIC	TOTAL	PERCENT
PERIODIC MOS	0.	0.	0.	0.	1396.	1396.	5.63
PREFLIGHT	3661.	0.	0.	0.	0.	3661.	14.78
DAILY MOS	0.	0.	19717.	0.	0.	19717.	79.59
TOTAL	3661.	0.	19717.	0.	1396.	24774.	100.00
PERCENT OF TOTAL	14.78	0.0	79.59	0.0	5.63	100.00	

b. RMS Inspection Cost

Figure 11 - Continued

INSPECTION AND UNSCHEDULED MAINTENANCE PERSONNEL COSTS

MOS LEVEL	DIRECT REGULAR	DIRECT OVERTIME	INDIRECT	TOTAL	PERCENT
ON A/C MOS	15714.	0.	56857.	72571.	30.00
PERIODIC MOS	2698.	0.	33587.	36285.	15.00
PREFLIGHT	3661.	0.	8434.	12095.	5.00
DAILY MOS	19717.	0.	28663.	48380.	20.00
ON A/C MOS	15714.	0.	56857.	72571.	30.00
TOTAL	57504.	0.	184398.	241902.	100.00
PERCENT OF TOTAL	23.77	0.0	76.23	100.00	

c. Inspection and Unscheduled Maintenance Personnel Costs

Figure 11 - Continued

SUBSYSTEM MAINTENANCE ACTION

SUBSYSTEM	AVUM NO. OF ON-EQUIP REPAIRS	AVUM NO. OF REMOVE REPLACE	AVUM NO. OF OFF-EQUIP REPAIRS	AVUM TOTAL COST	AVIM NO. OF REPAIRS	AVIM TOTAL COST	DEPOT NO. OF REPAIRS	DEPOT TOTAL COST	PART NO. OF CONDEMN	PART SALVAGE VALUE	PART PIPELINE REPL. COST	TOTAL COST	PERCENT OF TOTAL
STRUCTURE	8	0	0	1200.	0	0.	0	0.	0	0.	0.	1200.	0.61
ENGINE ASSY	13	23	8	17640.	2	98.	6	83150.	3	-15806.	52686.	137768.	70.17
ROTAT.COMPON	12	84	8	13171.	24	6788.	22	17836.	25	-8032.	26773.	56536.	28.80
HYDRAUL SYS	1	0	0	19.	0	0.	0	0.	0	0.	0.	19.	0.01
ELECTRICAL	2	7	4	306.	2	16.	0	0.	1	-14.	46.	354.	0.18
FLT CONTROLS	0	1	1	284.	0	0.	0	0.	0	0.	0.	284.	0.14
NAV/COM COMP	3	2	0	112.	3	60.	0	0.	0	0.	0.	172.	0.09
TOTAL	39	117	21	32732.	31	6962.	28	100986.	29	-23852.	79505.	196333.	100.00
PERCENT OF TOTAL				16.67		3.55		51.44			28.35	100.00	

d. Subsystem Maintenance Action Cost

Figure 11 - Continued

RMS COST SUMMARY

	COST/FLIGHT HOUR	TOTAL COST	PERCENT
DEPRECIATION	15.78	24656.	5.17
FLIGHT	29.85	46640.	9.78
DIRECT INSPECTION	15.86	24774.	5.20
INDIRECT PERSONNEL	118.01	184398.	38.67
MAINTENANCE	125.65	196333.	41.18
SYSTEM	305.15	476801.	100.00

TOTAL SIMULATION TIME (DAYS)	182.0
TOTAL FLIGHT TIME (HRS)	1562.5
UPTIME/TOTAL TIME	86.85
MISSIONS FLOWN/MISSIONS CALLED	100.00
MISSIONS COMPLETED/MISSIONS FLOWN	98.65

e. RMS Cost Summary

Figure 11 - Concluded

R&M DIVISION, PRODUCT ASSURANCE DIRECTORATE

R & M SIMULATION (RMS) MODEL

AIRCRAFT STATISTICS

TOTAL FLYING HOURS	1334.5
FLYING HOURS - COMPLETED MISSIONS	1307.0
FLYING HOURS - ABORTED MISSIONS	4.5
FLYING HOURS - TEST HOPS	23.0
MISSION RELIABILITY	99.31
SYSTEM MTBF	11.70
INHERENT AVAILABILITY	97.96
ACHIEVED AVAILABILITY	18.76
OPERATIONAL AVAILABILITY	18.76
MEAN TIME BETWEEN MAINTENANCE	11.60
MEAN TIME TO REPAIR	3.61
AVUM PREVENTIVE MMH/FH (INSPECTIONS & SERVICING)	1.62
AVUM SCHEDULED MMH/FH (INSPECTIONS & TBO'S)	1.62
AVUM CORRECTIVE MMH/FH	1.13
AVUM & INTERMEDIATE CORRECTIVE MMH/FH	1.36
INTERMEDIATE CORRECTIVE MMH/FH	.23
DEPOT CORRECTIVE MMH/FH	6.11
TOTAL CORRECTIVE MMH/FH	7.47

a. Basic RMS Output

Figure 12. RMS COST Model Output - OH-58 with Alternative 20 Maintenance Personnel Loading

RMS INSPECTION COST

MOS LEVEL	PREFLIGHT	POST FLIGHT	DAILY	INTERMEDIATE	PERIODIC	TOTAL	PERCENT
PERIODIC MOS	0.	0.	0.	0.	349.	349.	1.48
PREFLIGHT	3117.	0.	0.	0.	0.	3117.	13.21
DAILY MOS	0.	0.	20125.	0.	0.	20125.	85.31
TOTAL	3117.	0.	20125.	0.	349.	23591.	100.00
PERCENT OF TOTAL	13.21	0.0	85.31	0.0	1.48	100.00	

b. RMS Inspection Cost

Figure 12 - Continued

INSPECTION AND UNSCHEDULED MAINTENANCE PERSONNEL COSTS

MOS LEVEL	DIRECT REGULAR	DIRECT OVERTIME	INDIRECT	TOTAL	PERCENT
ON A/C MOS	8519.	1368.	88243.	98130.	40.09
PERIODIC MOS	873.	0.	35412.	36285.	14.82
PREFLIGHT	3117.	0.	8978.	12095.	4.94
DAILY MOS	20125.	0.	4066.	24191.	9.88
ON A/C MOS	8435.	1493.	64136.	74064.	30.26
TOTAL	41069.	2861.	200835.	244765.	100.00
PERCENT OF TOTAL	16.78	1.17	82.05	100.00	

c. Inspection and Unscheduled Maintenance Personnel Costs

Figure 12 - Continued

SUBSYSTEM MAINTENANCE ACTION

SUBSYSTEM	AVUM NO. OF ON-EQUIP REPAIRS	AVUM NO. OF REMOVE REPLACE	AVUM NO. OF OFF-EQUIP REPAIRS	AVUM TOTAL COST	AVIM NO. OF REPAIRS	AVIM TOTAL COST	DEPOT NO. OF REPAIRS	DEPOT TOTAL COST	PART NO. OF CONDEMN	PART SALVAGE VALUE	PART PIPELINE REPL. COST	TOTAL COST	PERCENT OF TOTAL
STRUCTURE	2	2	1	2952.	0	0.	0	0.	1	-5400.	18000.	15552.	10.42
ENGINE ASSY	6	12	4	6141.	0	0.	5	77744.	1	-5269.	17562.	96178.	64.42
ROTAT.COMPON	10	57	13	10023.	15	3681.	18	17094.	10	-2168.	7227.	35857.	24.02
INSTRUMENTS	1	3	0	354.	0	0.	0	0.	4	-166.	552.	740.	0.50
ELECTRICAL	2	5	3	555.	0	0.	0	0.	0	0.	0.	555.	0.37
FUEL	1	0	0	12.	0	0.	0	0.	0	0.	0.	12.	0.01
FLT CONTROLS	0	3	1	102.	1	3.	0	0.	1	-35.	116.	186.	0.12
NAV/COM COMP	5	4	2	202.	2	23.	0	0.	0	0.	0.	225.	0.15
TOTAL	27	86	24	20341.	18	3707.	23	94838.	17	-13038.	43457.	149305.	100.00
PERCENT OF TOTAL				13.62		2.48		63.52			20.37	100.00	

d. Subsystem Maintenance Action Cost

Figure 12 - Continued

RMS COST SUMMARY

	COST/FLIGHT HOUR	TOTAL COST	PERCENT
DEPRECIATION	15.78	21058.	4.85
FLIGHT	29.79	39760.	9.15
DIRECT INSPECTION	17.68	23591.	5.43
INDIRECT PERSONNEL	150.49	200835.	46.22
MAINTENANCE	111.88	149305.	34.36
SYSTEM	325.63	434549.	100.00

TOTAL SIMULATION TIME (DAYS)	182.0
TOTAL FLIGHT TIME (HRS)	1334.5
UPTIME/TOTAL TIME	18.76
MISSIONS FLOWN/MISSIONS CALLED	84.35
MISSIONS COMPLETED/MISSIONS FLOWN	99.31

e. RMS Cost Summary

Figure 12 - Concluded

R&M DIVISION, PRODUCT ASSURANCE DIRECTORATE

R & M SIMULATION (RMS) MODEL

AIRCRAFT STATISTICS

TOTAL FLYING HOURS	1568.0
FLYING HOURS - COMPLETED MISSIONS	1528.0
FLYING HOURS - ABORTED MISSIONS	16.0
FLYING HOURS - TEST HOPS	24.0
MISSION RELIABILITY	97.94
SYSTEM MTBF	6.81
INHERENT AVAILABILITY	97.31
ACHIEVED AVAILABILITY	86.84
OPERATIONAL AVAILABILITY	86.84
MEAN TIME BETWEEN MAINTENANCE	6.67
MEAN TIME TO REPAIR	3.99
AVUM PREVENTIVE MMH/FH (INSPECTIONS & SERVICING)	2.13
AVUM SCHEDULED MMH/FH (INSPECTIONS & TBO'S)	2.07
AVUM CORRECTIVE MMH/FH	2.04
AVUM & INTERMEDIATE CORRECTIVE MMH/FH	2.57
INTERMEDIATE CORRECTIVE MMH/FH	.53
DEPOT CORRECTIVE MMH/FH	8.42
TOTAL CORRECTIVE MMH/FH	10.99

a. Basic RMS Output

Figure 13. RMS COST Model Output - OH-58 with Alternative 36 Maintenance Personnel Loading

RMS INSPECTION COST

MOS LEVEL	PREFLIGHT	POST FLIGHT	DAILY	INTERMEDIATE	PERIODIC	TOTAL	PERCENT
PERIODIC MOS	0.	0.	0.	0.	1744.	1744.	6.86
PRLFLIGHT	3684.	0.	0.	0.	0.	3684.	14.50
DAILY MOS	0.	0.	19978.	0.	0.	19978.	78.63
TOTAL	3684.	0.	19978.	0.	1744.	25406.	100.00
PERCENT OF TOTAL	14.50	0.0	78.63	0.0	6.86	100.00	

b. RMS Inspection Cost

Figure 13 - Continued

INSPECTION AND UNSCHEDULED MAINTENANCE PERSONNEL COSTS

MOS LEVEL	DIRECT REGULAR	DIRECT OVERTIME	INDIRECT	TOTAL	PERCENT
ON A/C MOS	23951.	0.	121192.	145143.	33.33
PERIODIC MOS	3645.	0.	68926.	72571.	16.67
PREFLIGHT	3684.	0.	20506.	24190.	5.56
DAILY MOS	19978.	0.	28403.	48381.	11.11
ON A/C MOS	23951.	0.	121192.	145143.	33.33
TOTAL	75209.	0.	360219.	435428.	100.00
PERCENT OF TOTAL	17.27	0.0	82.73	100.00	

c. Inspection and Unscheduled Maintenance Personnel Costs

Figure 13 - Continued

SUBSYSTEM MAINTENANCE ACTION

SUBSYSTEM	AVUM NO. OF ON-EQUIP REPAIRS	AVUM NO. OF REMOVE REPLACE	AVUM NO. OF OFF-EQUIP REPAIRS	AVUM TOTAL COST	AVIM NO. OF REPAIRS	AVIM TOTAL COST	DEPOT NO. OF REPAIRS	DEPOT TOTAL COST	PART NO. OF CONDEMN	PART SALVAGE VALUE	PART PIPELINE REPL. COST	TOTAL COST	PERCENT OF TOTAL
STRUCTURE	4	3	1	1029.	2	404.	0	0.	0	0.	0.	1433.	0.46
ENGINE ASSY	15	34	10	25738.	3	221.	9	135331.	6	-31612.	105372.	235050.	75.52
ROTAT.COMPON	12	139	31	20399.	35	8886.	27	18285.	40	-10317.	34389.	71644.	23.02
HYDRAUL SYS	0	2	1	131.	0	0.	0	0.	1	-45.	150.	236.	0.08
INSTRUMENTS	2	3	1	247.	0	0.	0	0.	2	-84.	280.	443.	0.14
ELECTRICAL	6	8	4	497.	3	106.	0	0.	1	-5.	18.	616.	0.20
FUEL	1	0	0	5.	0	0.	0	0.	0	0.	0.	5.	0.00
FLT CONTROLS	2	7	6	1298.	1	12.	0	0.	0	0.	0.	1310.	0.42
NAV/COM COMP	8	4	0	458.	4	48.	0	0.	0	0.	0.	506.	0.16
TOTAL	50	200	54	49802.	48	9679.	36	153616.	50	-42063.	140209.	311243.	100.00
PERCENT OF TOTAL				16.00		3.11		49.36			31.53	100.00	

d. Subsystem Maintenance Action Cost

Figure 13 - Continued

RMS COST SUMMARY

	COST/FLIGHT HOUR	TOTAL COST	PERCENT
DEPRECIATION	15.78	24743.	3.22
FLIGHT	29.74	46640.	6.07
DIRECT INSPECTION	16.20	25406.	3.31
INDIRECT PERSONNEL	229.73	360219.	46.89
MAINTENANCE	198.50	311243.	40.51
SYSTEM	489.96	768251.	100.00

TOTAL SIMULATION TIME (DAYS)	182.0
TOTAL FLIGHT TIME (HRS)	1568.0
UPTIME/TOTAL TIME	86.84
MISSIONS FLOWN/MISSIONS CALLED	100.00
MISSIONS COMPLETED/MISSIONS FLOWN	97.94

e. RMS Cost Summary

Figure 13 - Concluded

R&M DIVISION, PRODUCT ASSURANCE DIRECTORATE

R & M SIMULATION (RMS) MODEL

AIRCRAFT STATISTICS

TOTAL FLYING HOURS	1468.5
FLYING HOURS - COMPLETED MISSIONS	1445.0
FLYING HOURS - ABORTED MISSIONS	9.5
FLYING HOURS - TEST HOPS	14.0
MISSION RELIABILITY	98.70
SYSTEM MTBF	9.59
INHERENT AVAILABILITY	88.03
ACHIEVED AVAILABILITY	82.98
OPERATIONAL AVAILABILITY	82.95
MEAN TIME BETWEEN MAINTENANCE	9.35
MEAN TIME TO REPAIR	4.36
AVUM PREVENTIVE MMH/FH (INSPECTIONS & SERVICING)	1.30
AVUM SCHEDULED MMH/FH (INSPECTIONS & TBO'S)	1.24
AVUM CORRECTIVE MMH/FH	1.57
AVUM & INTERMEDIATE CORRECTIVE MMH/FH	1.73
INTERMEDIATE CORRECTIVE MMH/FH	.16
DEPOT CORRECTIVE MMH/FH	7.74
TOTAL CORRECTIVE MMH/FH	9.47

a. Basic RMS Output

Figure 14. RMS COST Model Output - OH-58 with 4-Aircraft Fleet

RMS INSPECTION COST

MOS LEVEL	PREFLIGHT	POST FLIGHT	DAILY	INTERMEDIATE	PERIODIC	TOTAL	PERCENT
PERIODIC MOS	0.	0.	0.	0.	1396.	1396.	11.70
PREFLIGHT	3438.	0.	0.	0.	0.	3438.	28.81
DAILY MOS	0.	0.	7099.	0.	0.	7099.	59.49
TOTAL	3438.	0.	7099.	0.	1396.	11933.	100.00
PERCENT OF TOTAL	28.81	0.0	59.49	0.0	11.70	100.00	

b. RMS Inspection Cost

Figure 14 - Continued

INSPECTION AND UNSCHEDULED MAINTENANCE PERSONNEL COSTS

MOS LEVEL	DIRECT REGULAR	DIRECT OVERTIME	INDIRECT	TOTAL	PERCENT
ON A/C MOS	16562.	1811.	56009.	74382.	30.27
PERIODIC MOS	2089.	0.	34197.	36286.	14.77
PREFLIGHT	3438.	0.	8657.	12095.	4.92
DAILY MOS	7099.	0.	41282.	48381.	19.69
ON A/C MOS	16425.	2017.	56146.	74588.	30.35
TOTAL	45613.	3828.	196291.	245732.	100.00
PERCENT OF TOTAL	18.56	1.56	79.88	100.00	

c. Inspection and Unscheduled Maintenance Personnel Costs

Figure 14 - Continued

SUBSYSTEM MAINTENANCE ACTION

SUBSYSTEM	AVUM NO. OF ON-EQUIP REPAIRS	AVUM NO. OF REMOVE REPLACE	AVUM NO. OF OFF-EQUIP REPAIRS	AVUM TOTAL COST	AVIM NO. OF REPAIRS	AVIM TOTAL COST	DEPOT NO. OF REPAIRS	DEPOT TOTAL COST	PART NO. OF CONDEMN	PART SALVAGE VALUE	PART PIPELINE REPL. COST	TOTAL COST	PERCENT OF TOTAL
STRUCTURE	6	3	2	1944.	1	9.	0	0.	0	0.	0.	1953.	0.81
ENGINE ASSY	9	19	3	17565.	2	112.	10	108675.	4	-21074.	70248.	175526.	72.96
ROTAT.COMPON	18	89	11	16652.	14	2634.	33	23652.	26	-7946.	26486.	61478.	25.55
HYDRAUL SYS	2	2	2	387.	0	0.	0	0.	0	0.	0.	387.	0.16
INSTRUMENTS	2	1	0	56.	0	0.	0	0.	1	-59.	195.	192.	0.08
ELECTRICAL	5	7	2	355.	2	98.	0	0.	1	-5.	18.	466.	0.19
FUEL	1	0	0	35.	0	0.	0	0.	0	0.	0.	35.	0.01
FLT CONTROLS	1	2	1	251.	1	8.	0	0.	0	0.	0.	259.	0.11
NAV/COM COMP	5	2	1	264.	1	21.	0	0.	0	0.	0.	285.	0.12
TOTAL	49	125	22	37509.	21	2882.	43	132327.	32	-29084.	96947.	240581.	100.00
PERCENT OF TOTAL				15.59		1.20		55.00			28.21	100.00	

d. Subsystem Maintenance Action Cost

Figure 14 - Continued

RMS COST SUMMARY

	COST/FLIGHT HOUR	TOTAL COST	PERCENT
DEPRECIATION	15.78	23173.	4.49
FLIGHT	29.84	43820.	8.50
DIRECT INSPECTION	8.13	11933.	2.31
INDIRECT PERSONNEL	133.67	196291.	38.06
MAINTENANCE	163.83	240581.	46.64
SYSTEM	351.24	515798.	100.00

TOTAL SIMULATION TIME (DAYS)	182.0
TOTAL FLIGHT TIME (HRS)	1468.5
UPTIME/TOTAL TIME	82.95
MISSIONS FLOWN/MISSIONS CALLED	93.84
MISSIONS COMPLETED/MISSIONS FLOWN	98.70

e. RMS Cost Summary

Figure 14 - Concluded

R&M DIVISION, PRODUCT ASSURANCE DIRECTORATE

R & M SIMULATION (RMS) MODEL

AIRCRAFT STATISTICS

TOTAL FLYING HOURS	1433.0
FLYING HOURS - COMPLETED MISSIONS	1409.0
FLYING HOURS - ABORTED MISSIONS	12.0
FLYING HOURS - TEST HOPS	12.0
MISSION RELIABILITY	98.32
SYSTEM MTBF	10.02
INHERENT AVAILABILITY	92.35
ACHIEVED AVAILABILITY	88.07
OPERATIONAL AVAILABILITY	87.90
MEAN TIME BETWEEN MAINTENANCE	9.74
MEAN TIME TO REPAIR	3.13
AVUM PREVENTIVE MMH/FH (INSPECTIONS & SERVICING)	.95
AVUM SCHEDULED MMH/FH (INSPECTIONS & TBO'S)	.88
AVUM CORRECTIVE MMH/FH	1.12
AVUM & INTERMEDIATE CORRECTIVE MMH/FH	1.53
INTERMEDIATE CORRECTIVE MMH/FH	.41
DEPOT CORRECTIVE MMH/FH	1.49
TOTAL CORRECTIVE MMH/FH	3.02

a. Basic RMS Output

Figure 15. RMS COST Model Output - OH-58 with 3-Aircraft Fleet

			RMS INSPECTION COST				
MOS LEVEL	PREFLIGHT	POST FLIGHT	DAILY	INTERMEDIATE	PERIODIC	TOTAL	PERCENT
PERIODIC MOS	0.	0.	0.	0.	1396.	1396.	13.61
PREFLIGHT	3361.	0.	0.	0.	0.	3361.	32.76
DAILY MOS	0.	0.	5503.	0.	0.	5503.	53.64
TOTAL	3361.	0.	5503.	0.	1396.	10260.	100.00
PERCENT OF TOTAL	32.76	0.0	53.64	0.0	13.61	100.00	

b. RMS Inspection Cost

Figure 15 - Continued

INSPECTION AND UNSCHEDULED MAINTENANCE PERSONNEL COSTS

MOS LEVEL	DIRECT REGULAR	DIRECT OVERTIME	INDIRECT	TOTAL	PERCENT
ON A/C MOS	10155.	1026.	62416.	73597.	30.25
PERIODIC MOS	2868.	0.	33418.	36286.	14.92
PREFLIGHT	3361.	0.	8734.	12095.	4.97
DAILY MOS	5503.	0.	42877.	48380.	19.89
ON A/C MOS	10605.	351.	61966.	72922.	29.97
TOTAL	32492.	1377.	209411.	243280.	100.00
PERCENT OF TOTAL	13.36	0.57	86.08	100.00	

c. Inspection and Unscheduled Maintenance Personnel Costs

Figure 15 - Continued

SUBSYSTEM MAINTENANCE ACTION

SUBSYSTEM	AVUM NO. OF ON-EQUIP REPAIRS	AVUM NO. OF REMOVE REPLACE	AVUM NO. OF OFF-EQUIP REPAIRS	AVUM TOTAL COST	AVIM NO. OF REPAIRS	AVIM TOTAL COST	DEPOT NO. OF REPAIRS	DEPOT TOTAL COST	PART NO. OF CONDEMN	PART SALVAGE VALUE	PART PIPELINE REPL. COST	TOTAL COST	PERCENT OF TOTAL
STRUCTURE	5	5	2	1622.	2	199.	1	314.	0	0.	0.	2135.	1.62
ENGINE ASSY	8	17	3	6206.	2	33.	3	4673.	5	-26343.	87810.	72379.	54.86
ROTAT.COMPON	11	89	17	14679.	18	6529.	22	19985.	26	-6397.	21322.	56118.	42.54
INSTRUMENTS	0	1	0	49.	0	0.	0	0.	1	-20.	67.	96.	0.07
ELECTRICAL	3	12	8	573.	2	34.	0	0.	1	-1.	4.	610.	0.46
FLT CONTROLS	0	2	1	266.	1	2.	0	0.	0	0.	0.	268.	0.20
NAV/COM COMP	3	3	2	214.	1	108.	0	0.	0	0.	0.	322.	0.24
TOTAL	30	129	33	23609.	26	6905.	26	24972.	33	-32761.	109203.	131928.	100.00
PERCENT OF TOTAL				17.90		5.23		18.93			57.94	100.00	

d. Subsystem Maintenance Action Cost

Figure 15 - Continued

RMS COST SUMMARY

	COST/FLIGHT HOUR	TOTAL COST	PERCENT
DEPRECIATION	15.78	22613.	5.42
FLIGHT	29.83	42750.	10.25
DIRECT INSPECTION	7.16	10260.	2.46
INDIRECT PERSONNEL	146.13	209411.	50.22
MAINTENANCE	92.06	131928.	31.64
SYSTEM	290.97	416962.	100.00

TOTAL SIMULATION TIME (DAYS)	182.0
TOTAL FLIGHT TIME (HRS)	1433.0
UPTIME/TOTAL TIME	87.90
MISSIONS FLOWN/MISSIONS CALLED	91.85
MISSIONS COMPLETED/MISSIONS FLOWN	98.32

e. RMS Cost Summary

Figure 15 - Concluded